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ROENTGENOGRAPHIC PELVIMETRY AND FETALOMETRY

ELIMINATION OF ERRORS DUE TO MOVEMENTS BETWEEN X-RAY EXPOSURES

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SEVERAL radically different methods have been proposed for the measurement of the pelvis and fetus, each having its disadvantages, but all possessing merit. Thoms (8) has advocated the position or frame method which requires the exposure of an opaque frame or diaphragm with perforations one centimeter apart following the exposure of the mother's pelvis, the former being placed parallel to the film at the same distance above it as the inlet of the pelvis, in order to produce equal distortion of the centimeter ruling and the pelvis at the level of the inlet. For accuracy, such a method should fulfill the following requirements: (1) The pelvis of the mother must be orientated in such a manner that the plane of the inlet is approximately parallel to the film surface for the exposure; (2) External points on the mother must be available corresponding with this plane; (3) Accurate substitution of the perforated grid for the pelvis of the mother must be made for the second exposure, and (4) the x-ray tube and film must not be moved between the exposures. The meas-

urements of the anteroposterior and transverse diameters of the inlet can be obtained directly by counting the number of centimeter dots cast on the film along these diameters. The disadvantages of this method are that a special apparatus is required for placing the mother in a position approximately halfway between the sitting and supine positions in order to place the inlet of the pelvis parallel with the film surface; the x-ray beam must pass through the long diameter of the contents of the uterus, and measurements of the fetal head are made with difficulty.

A second method possessing considerable accuracy which relates to direct measurements of the phantom image of the diameters of the pelvis by stereoscopic vision has been described by Caldwell and Moloy (2). Two films of the pelvis are obtained in sequence, employing a standardized tube shift between the two exposures. For accurate measurement a "precision stereoscope" must be available. This requires exact centering of the optical apparatus in relation to both the film surfaces and the eyes, with accurate adjustments for variations in the interpupillary distance of the individual. When proper adjustments are made, the diameters of the pelvis may be

¹ The writers desire to express their appreciation for the constant help afforded them by Mr. Herbert Merma-gen, chief technician, who assisted them materially in gaining technical refinements and who is responsible for taking most of the radiographs of this series.

obtained by inserting the scale (true centimeter or inch) in the virtual image behind the optical system using a black surface for a background to aid in visualizing the image in subdued light. The limitations of the method are essentially three in number, *viz.*: only persons possessing highly de-

veloped stereoscopic vision may use the method; the common stereoscopes used in roentgenological work to-day are not of a type to permit precision work, and movement of the fetus between exposures will result in incorrect measurements of the fetal head.

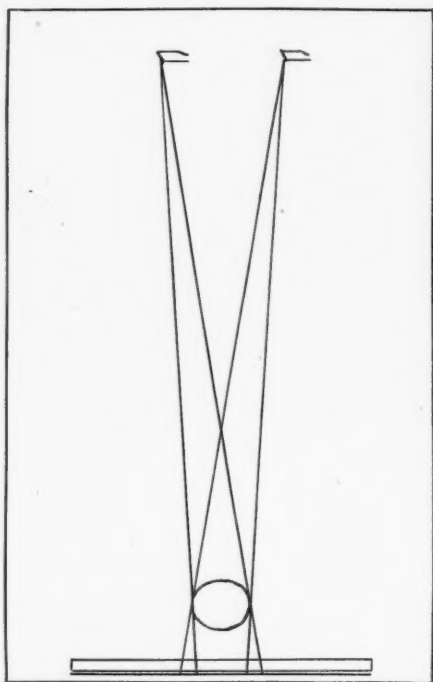


Fig. 1.

Fig. 1. Diagram showing the relations between the fetal head and the two shadows of the head cast on the film in respect to the two focal spots of the tubes. By employing rubber threads or wire on the doubly exposed film, one may reconstruct in space the manner in which the x-ray beam emanating from each focal spot passed to cast its shadow. The points at which the threads cross represent the relative and absolute position of forehead and occiput in space at the time of the x-ray examination. In practice, either the position of the forehead or occiput may be determined, first leaving a marker in space to preserve its position and, after determining the position of the second, a centimeter or inch rule inserted in space between the two positions permits the direct reading of the anteroposterior diameter of the skull. Points on the maternal pelvis may be identified in similar manner and pelvic diameter determined. In this illustration the single black line represents the film beneath the table top.

Fig. 2. Side view of phantom with elastic cords, showing the manner of the crossing of the threads and the metallic pointers preserving the points in space for the later use of the centimeter rule.

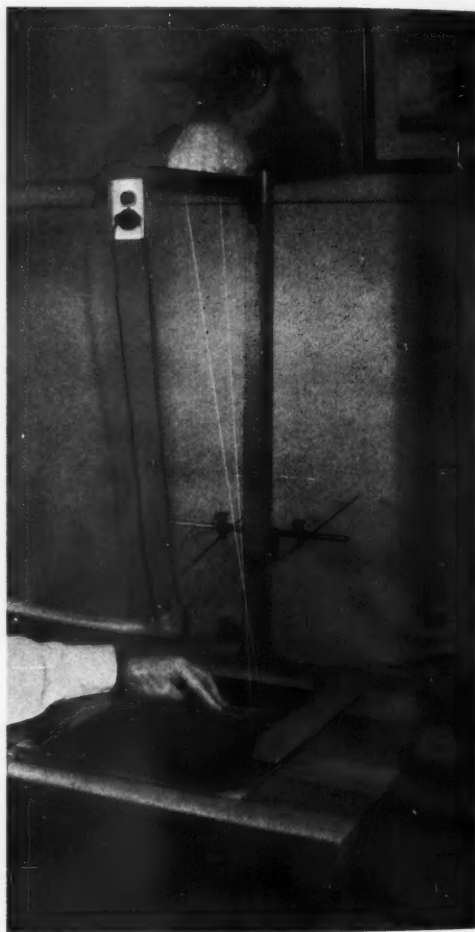


Fig. 2.

Ball and Marchbanks (1) have in recent years described an original method permitting comparison of the volume capacity of the maternal pelvis with that of the fetal head. This method employs a mechanical device for tracing the outline of the circumference of the fetal skull in the anteropos-

work. The method would appear to be open to at least one objection: movements of the fetal head between the two exposures will result in inaccuracies. Hodges has suggested a special apparatus, an obstetrical jacket, to maintain the mother in proper standing position for two exposures.

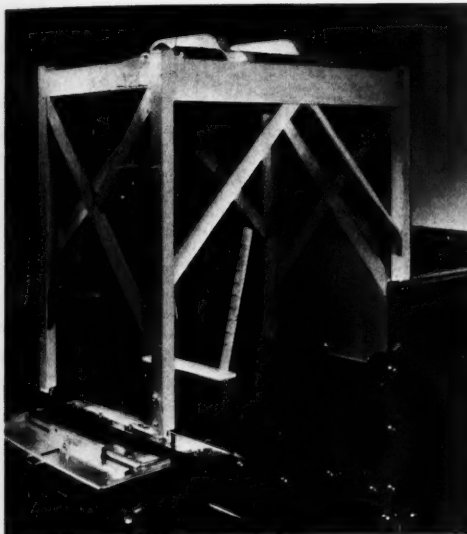


Fig. 3.

Fig. 3. Two tubes mounted at the top of the standard, fixing permanently both the distance between the tubes and the target-film distance. This equipment is centered in respect to the film by the pointer at lower end of leg of standard in the foreground (automatically), bringing the Bucky tray with its film into proper position. A test object with a series of opaque rods at varying distances from the film has been placed on the table top. A plumb bob suspended by the upper part of the carriage midway between the focal spots of the tubes serves to center the fetal head on maternal pelvis.

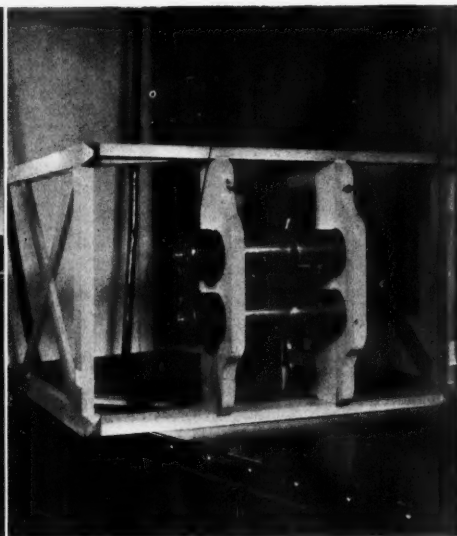


Fig. 4.

Fig. 4. The tube standard has been placed on its side to show the alignment and fixation of the two x-ray tubes.

terior and lateral projection and the true conjugate and bi-ischial diameters of the maternal pelvis. The instrument provides means for correcting for distortion, for conversion of circumference of the fetal head into a volume measurement, and similar conversion of diameters (maternal pelvis) into volume measurements. By making allowances for scalp thickness, molding of head, compression of scalp volume, the volume capacities may be directly compared. This method provides a novel approach to the problem, but it remains for the future to determine its dependability in routine

A fourth, and exceedingly common method of pelvic mensuration relating to triangulation, has been developed by Manges (7), Chamberlain and Newell (3), Johnson (6), Hodges (5) and others, and is commonly known as the cross-thread method of Mackenzie-Davidson. Two films of the maternal pelvis are obtained in succession, shifting the tube a known distance between exposures. In the cross-string method identical points are obtained by stereoscopic vision. The course of the x-ray beam is reconstructed by means of a phantom which employs two strings or wires to

trace out in space the path of the beams of the x-ray tube (Figs. 1 and 2). By orientating the film in exactly the same relation in respect to the phantom that existed between the film and tube during the two exposures, one may identify the exact path of the beam for any selected point, such as right lateral border of inlet. This point is located in space at the point of crossing of the two strings. By leaving a marker in space (point of rod) one may proceed to determine the location in space of the other end of the diameter under consideration (left lateral border of inlet). By measurement of the distance between these two points in space, the transverse diameter is obtained. In similar fashion, one may proceed to measure the other diameters in turn including the maximum anteroposterior diameter of the fetal head.

This method is fundamentally accurate in all cases in which identical points of the two films can be obtained by stereoscopy. The method possesses the same disadvantages as noted in the stereoscopic method: the individual must have well developed stereoscopic vision which requires a correct intracerebral integration of the two retinal images. There is also an additional disadvantage in this method in that the corresponding points of the true conjugate are difficult to identify by stereoscopy, even by individuals showing no limitation in stereoscopic vision, and, the films being obtained in succession, permits movement of the fetus to occur between exposures, resulting in inaccuracies in determinations of fetal head size.

We have modified this method with the following aims in mind: (1) to eliminate fetal movements; (2) to remove the need for stereoscopic vision; (3) to prevent inaccuracies arising from failure to exactly reduplicate the position of the films in respect to the x-ray tube, and, lastly (4), to reduce the cost of the examination. As finally developed, the equipment consists of a standard (Figs. 3 and 4) for supporting two x-ray tubes above the patient at a constant distance above the film surface with a constant interfocal distance between the

tubes. The standard is notched-out for reception of the tubes, thereby preventing the position of the tubes from shifting. This eliminates the need of any shift of the tube or tubes during the examinations and eradicates any errors which might arise as a result of incorrect shifting. From the central position of the equipment, midway between the two focal spots of the tubes, a plumb bob is suspended to center the equipment in respect to the Bucky diaphragm and the film beneath its grid.

The patient is then adjusted to position so that the pelvis overlies the film. A unique feature of this technic is the simultaneous exposure of the film by both tubes, the intensity of each beam of radiation being independently controlled by separate filament transformers. This is desirable since the amount of tissue penetrated by the two beams is different, though the target-film distance is maintained constant. The beam from the lower tube passes through less tissue because of the configuration of the lower pregnant abdomen. A bag of rice flour molded over the lower abdomen will in part compensate for this, but we have found it extremely desirable to control the amount of current passing through each tube at will. The film when exposed shows double silhouettes of both the maternal pelvis and the fetal head (Fig. 5). This may seem to be a disadvantage but, in fact, it saves the time required in making exact superimpositions of the two films, matching of opaque markers, punching out of points, or tracing of both silhouettes on a sheet of drawing paper, and at the same time it eliminates any error which arises in the execution of the technic. The corresponding points on the pelvis (Fig. 6) are marked directly on the film. They are: the points farthest from the midline, representing the ends of the maximum transverse diameter; the points of the two oblique diameters extending between points on the sacro-iliac synchondrosis and the ileopectineal eminences of the superior pubic rami, and points at the ischial tuberosities representing the ends of the interischial diameter. We have found that the

true conjugate diameter cannot be reliably obtained by this method, because it is impossible to identify accurately the sacral

resection charts, or special instrument (Thoms' method). This lateral projection (Fig. 7) also gives most valuable informa-



Fig. 5.



Fig. 6.

Fig. 5. A doubly exposed film showing the two shadows of a single fetal head with black dots marking similar points on the calvarium of the fetus. To determine the occipitofrontal diameter, the points showing maximum separation at forehead and occiput are selected for one of the shadows of the head, and similar points also showing maximum separation are selected for the second shadow of the head, which permit the occipitofrontal diameter of the skull to run in a plane parallel with the first. The results are not invalidated by a moderate amount of rotation of the head of the fetus but they cannot be determined in this manner in cases with marked rotation. Under the latter conditions the mother must be rolled into a partly oblique projection to render the anteroposterior diameter of the skull more nearly parallel to the film surface. The metallic rod (10 cm.) is always measured for control purposes.

Fig. 6. Maternal pelvis showing points selected for mensuration of pelvic diameters, the film being singly exposed for purpose of this illustration to avoid confusion. Note that the true conjugate is not measured by this method. If this is attempted, error is apt to occur due to the difficulty in identifying the promontory of the sacrum. The points of the right and left oblique, widest transverse and intertuberous diameters are shown, as well as the points on the fetal head for determining the fronto-occipital diameter. The metallic markers in the upper position of the abdomen were used for test purposes.

promontory cast by either of the two tubes. This same defect is inherent in the cross-string method as carried out by Johnson. The inlet is not parallel with the film surface and corresponding points are not determined even if stereoscopy is employed. It is believed by the writers that the true conjugate is best determined by a lateral projection, employing an opaque centimeter scale at the midsagittal plane of the body, fold of buttocks, permitting direct measurement of the true conjugate diameter of the inlet without the need of graphs, cor-

rection concerning the size of the sacro-iliac notches, contour of sacrum, pelvic inclination, and data concerning the outlet. This type of lateral film is desirable, regardless of the technic used for the anteroposterior projections—whether stereoscopic, frame, cross-thread, or the volume capacity technic. We use an erect standing position for the patient with a target-film distance of 76 cm., placing the centimeter scale of brass in the upper part of the fold of the buttocks. The true conjugate is then made by using the distorted centimeter scale on the

film for measuring the distance between the anterior aspect of the first sacral segment and the posterior aspect of the pubic

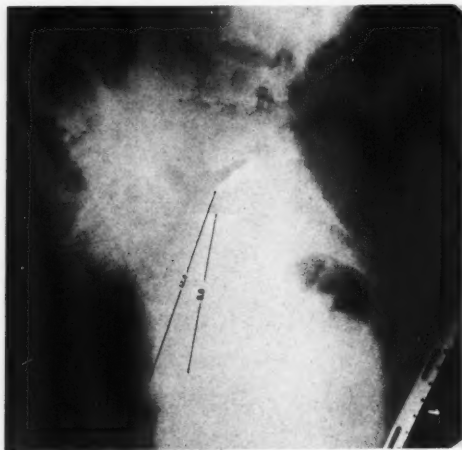


Fig. 7. Lateral projection of pelvis showing true conjugate diameter of the maternal pelvis and transverse diameter of fetal head (Thoms' method).

symphysis immediately below the superior margin. Thus by use of only two films all the essential diameters of the pelvis usually determined by other technics are obtained with either fewer films, decrease in the possibilities for error, or both.

The accuracy of the proposed method in measuring a linear object such as a rod was determined in this series by placing a brass rod 10 cm. in length on top of the abdomen during the exposure, a position in which distortion is greater than at the level of the maternal pelvis or fetal head. The length of the rod was determined by the cross-thread method in a large series in this manner with the results shown in Table I. When the metallic object is directly exposed without the interposition of the heavy maternal abdomen, the measurements correspond accurately without any variation (accurate within 1 mm.). The 1 or 2 mm. variation obtained when a subject is employed appears to be due to two causes: the ends of the rods are often not sharply demarcated due to lack of contrast

resulting from x-raying the object through the thick heavy parts of the subject, or the straight rod, unless firmly anchored by adhesive, may rock slightly on the rounded contour of the abdomen.

Greater variation is to be expected in measuring fetal head size, because of the changes in shape and alterations in cephalic diameters occurring during the passage of the head through the birth canal. The roentgenologic measurements are frequently taken prior to the descent of the head before molding has occurred, while the clinical measurements are made very shortly after this descent has been completed (day of birth). Furthermore, variations must of necessity be present due to the manner in which the measurements are made. The measurements of the diameter, for example, are made roentgenologically by selecting the longest diameter between points on the outer table of the frontal and occipital bones, while the clinical measurements are made by selecting points at the skin surface, using moderate compression. All clinical measurements in this study were made by a single individual (W. T. P.), avoiding variations due to the personal equation as much as possible, but even under such circumstances the clinical measurements should exceed the measurements determined between bony points, and if molding has been extreme or a large caput is present at the level of the occipitofrontal diameter, the clinical diameter may greatly exceed the diameter determined by roentgenography.

To permit comparison, a constant allowance of 5 mm. was made for skin thickness over both frontal and occipital regions, this measurement being added to each of those made roentgenologically. A comparison of the two sets of measurements is shown in Table II. It was felt that in view of possible molding effects a reasonably close approximation might have been assumed to be present if the variation did not exceed 5 mm. That the effects of molding may exceed this amount is to be admitted, but for the purpose of this analysis it was thought advisable to search for other fac-

tors as a cause of variation. Three-fifths of the cases were found to fall within the limit of 5 mm. variation, leaving 24 cases deserving further analysis.

A review of our cases (Table III) shows that one-half of the 24 cases showed such a marked degree of rotation that foreshortening of the x-ray shadow should be

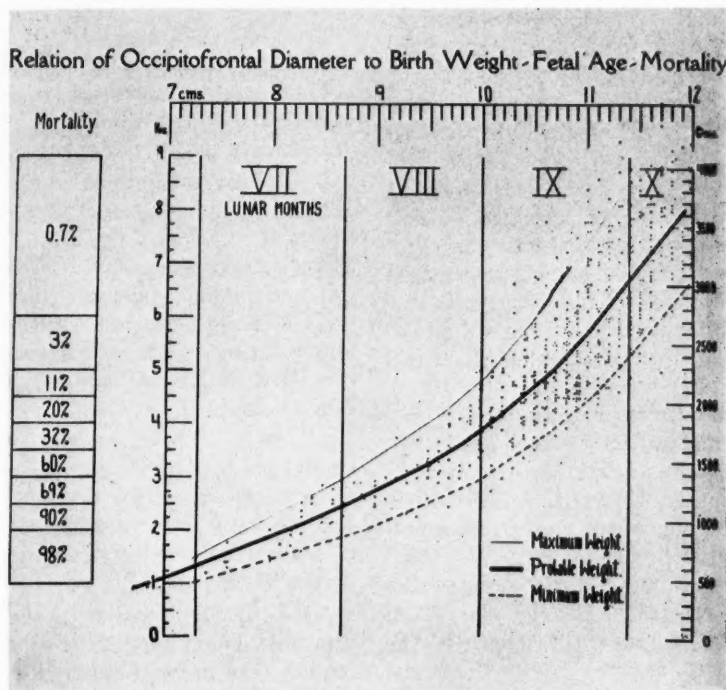


Fig. 8. Chart by S. H. Clifford. (West Virginia Med. Jour., 31, 3, 1935.)

The following factors may be considered as potential sources for these discrepancies: marked rotation of the fetal head within the pelvis resulting in foreshortening (abnormally short occipitofrontal diameter); considerable elapse of time between the roentgen-ray examination and the birth of the baby; marked deformity of the head as a result of application of forceps or the deformation of the head, or a very large caput, or a combination of the preceding factors.

expected. Three cases showed a long time interval between examinations (from 15 to 21 days), and in these cases the continued growth of the head following the roentgenological examination was probably an important factor.

There were nine cases remaining which were more difficult of analysis, and in which it was questionable whether the x-ray or clinical measurement of the head more nearly approached the true size of the occipitofrontal diameter of the cranium. Clif-

TABLE I.—VARIATIONS IN MEASUREMENT OF 10 CM. CONTROL ROD

No Variation	No. Determinations within 1 mm.	No. Determinations within 2 mm.	No. in Excess of 2 mm.	Total
23	30	11	0	64

ford's correlation chart (Fig. 8) was used to determine which of the two sets of measurements corresponded more closely to the predicted values of the occipitofrontal diameter, this prediction being based on body weight, a value entirely independent of such factors as molding, distortion of head, and the personal equation. Subjected to such an analysis, five out of the nine remaining cases showed close correlation between roentgenologic and predicted values based on weight, and a poor correlation between the clinical measurement and the predicted measurement. This suggested that in all probability the clinical measurement could not be determined with accuracy due to head deformation or that marked change in head shape had occurred during the passage of the head through the birth canal.

There remain only four cases which cannot be explained on the basis of head rotation, extensive head deformation, or time interval elapsing between examinations. In two of these four cases, the opaque metal rod was measured without error, the third showing one millimeter variation, and the last two millimeters variation. The reason why we could measure the length of the rod which was approximately the same length as the occipitofrontal diameter of the fetal skull without any appreciable error, but were unable to obtain similar accuracy with the diameter of the skull, remains obscure at this time but will form an objective for our future work.

CONCLUSIONS

1. A triangulation method employing the cross-thread principle has been described which permits simultaneous energizing of two x-ray tubes casting a double image of the object to be measured on a single film.

2. The length of a linear object, such as a 10 cm. rod, is commonly measured with variation of one millimeter or less in approximately five-sixths of the cases.

3. A solid object such as the fetal head offers more difficulty due principally to the effects of rotation of the head. This error, which occurred in only one-fifth of our series, can perhaps be largely eliminated in the future by securing a doubly exposed film, rotating the patient in such a manner that the maximum diameter of the fetal skull is obtained.

4. Pelvic measurements may be secured by the same method (anteroposterior film) except for the true conjugate. For this measurement a lateral film should be obtained which may be easily measured by the Thoms' method.

5. This modification of the triangulation method possesses three advantages, namely, the method employing simultaneous use of two x-ray tubes prevents movements of fetal parts which frequently occurs when films in succession are obtained; the fixed character of the apparatus prevents errors of a technical character due to variation in tube-film distances and tube

TABLE II.—VARIATIONS IN MEASUREMENTS OF THE OCCIPITOFRONTAL DIAMETER OF THE FETAL HEAD MADE BY ROENTGENOLOGIC MEANS (PRIOR TO BIRTH), WITH COMPARISON OF THE SAME DIAMETER DETERMINED CLINICALLY SHORTLY AFTER BIRTH

Total, 60 cases						
No Variation	1 mm.	2 mm.	3 mm.	4 mm.	5 mm.	Over 5 mm.
5	8	4	4	10	5	24

TABLE III.—VARIATIONS EXCEEDING 5 MM. IN THE OCCIPITOFRONTAL DIAMETER OF THE FETAL SKULL (24 CASES) PROBABLY DUE TO—

Rotation of Head	Time Interval between Examinations	Deformation of Head	Combination of Preceding	Unexplained
12	3	4	1	4

shifts, or failure to superimpose films accurately for use in measuring device, and the cost of the examination is reduced by substituting a single doubly exposed film for a pair of stereoscopic films.

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THE LANGUAGE OF ENGINEERS AND RADIOLOGISTS¹

NEW X-RAY TERMS PROPOSED: RHEGMA, RHOTHION, KLUDON, PLEM, AITH

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RADIOLOGY and illumination concern parts of the electromagnetic spectrum. I think they are parallel fields, and I think their terms and defini-

nomics of production of light. We observe that his international unit (the candle) refers to a source. The physician is interested in the patient. We observe that

LIGHT		X-RAY	
UNIT	CONCEPT	UNIT	
A ERG	RADIATION	ERG	
B WATT	RADIANT FLUX	WATT	
C LUMEN	LUMINOUS FLUX	ROENTGEN FLUX	KLUDON
D CANDLE	INTENSITY OF SOURCE	PLEM	
E CANDLE PER CM ² APPARENT AREA	BRIGHTNESS OF SOURCE	PLEM PER CM ² APPARENT AREA (AITH)	
F PHOT (929 FOOT CANDLES)	ILLUMINATION (LUMINOUS FLUX DENSITY)	IRRADIATION (ROENTGEN FLUX DENSITY)	RHOTHION (KLUDON PER CM ²) (ROENTGEN PER SEC)
G PHOT-SEC.	(TIME INTEGRAL OF ILLUMINATION)	EXPOSURE (TIME INTEGRAL OF IRRADIATION) ("QUANTITY OF X-RAY" BY INTERNATIONAL DEFINITION)	RHOTHION-SEC. (ROENTGEN WITHOUT BACKSCATTER)
H LUMEN-HOUR	QUANTITY OF LIGHT	QUANTITY OF X-RAY (STRICTLY) (TIME INTEGRAL OF ROENTGEN FLUX) (AREA INTEGRAL OF ROENTGENS)	KLUDON-SEC. (SQUARE CENTIMETER- ROENTGEN)
I LUMEN PER WATT	LUMINOSITY FACTOR (OF A GIVEN WAVELENGTH)	COEFFICIENT OF ABSORPTION (τ PLUS σ_a)	PER CM IN AIR
J		BIOLOGIC FACTOR	NO STANDARD OBJECT
K LUMEN PER WATT	LUMINOUS EFFICIENCY (OF RADIATION)	ROENTGEN EFFICIENCY (OF A BEAM)	KLUDON PER WATT
L LUMEN PER WATT INPUT	EFFICIENCY OF A LAMP	EFFICIENCY OF AN X-RAY TUBE (FOR MEDICAL PURPOSES)	KLUDON PER WATT INPUT
M		TISSUE DOSE (TIME INTEGRAL OF IONIZATION PER UNIT MASS)	RHEGMA

Table I.

tions ought to be parallel, but find they are not.

The engineer is interested in the eco-

his international unit (the roentgen) refers to an effect. Standardization in the two fields has proceeded from opposite ends.

Another point of difference in interest is time. Light is used for seeing. Except

¹ Read before the Fifth International Congress of Radiology, in Chicago, Sept. 13-17, 1937.

for very short exposures, we are not conscious of any accumulation. But for radiology the increase of effect with lengthening exposure is fundamental.

In Table I, I have listed analogous concepts and units for the two fields. Where no name exists for the x-ray analogue, I have invented one.

NOTES ON THE TABLE

A The most fundamental quantitative aspect of any radiation is the energy it contains.

B 1 watt = 1 joule per sec. = 10^7 ergs per sec. = 0.239 small calories per sec.

C Quoting the definitions given in the Report on Definitions of Electrical Terms, sponsored by the American Institute of Electrical Engineers,

"Light is radiant energy evaluated according to its capacity to produce visual sensation."

"Luminous flux is the time rate of flow of light." We wish now to name an analogous concept:

Roentgen flux is the time rate of flow of radiant energy evaluated according to its capacity to produce ionization (per unit length of path in air).

One *kludon* is the roentgen flux per unit solid angle emitted by a unit source.

D The *intensity* of a source is its solid-angular flux density in a given direction. From the luminous unit (1 candle) this is 1 lumen per steradian. From a source of unit roentgen intensity (1 *plem*, shall we call it?), it is 1 kludon per steradian.

This defines the word "intensity" precisely, but we often use it loosely. We may say "an intense light" when we mean an intense source, but also when we mean a bright (concentrated) source or even when what we mean is high illumination. When a physician says "intense x-ray" he probably means high total roentgens to a limited area. He might mean many roentgens per second. When he wishes to express the idea of an in-

tense source he will most likely call it a "fast x-ray tube."

In an incandescent electric lamp one is interested in total flux, *i.e.*, lumens; but in a searchlight one is interested in intensity, *i.e.*, candle power. So, for therapy one is interested in plems (intensity) rather than in kludons (total roentgen flux). So if a manufacturer advertises the power of his therapy apparatus in quantitative terms, it is plems, not kludons, he will write about. (This distinction would be of more importance if one could reflect x-rays from a parabolic mirror and so make an x-ray searchlight.)

E Brightness = intensity \div apparent area (for both light and x-ray).

One must note, however, one large practical difference: Take a perfectly diffusing surface of finite area. It looks just as bright if viewed obliquely, but its apparent area is less. So it appears less intense. But take a flat x-ray source. It appears just about as intense measured off at even quite a high angle. Its apparent area being less, its brightness must be greater.

For light: $Intensity \sim \cos. \theta$

For x-ray: $Brightness \sim \sec. \theta$

We remark in passing that the diffusion of light and the scattering of x-rays are not the same.

F A corollary of the cosine law for brightness is the falling off of illumination at oblique angles. But in x-ray we are interested in a volume effect, namely, the ionization produced by the radiation as it passes through (and is somewhat absorbed by) the superficial layers (and in the depth) of the body irradiated. This means that the obliquity of the surface is of almost no importance and we will always take the roentgen flux density through an area perpendicular to the beam.

Note that *brightness* refers to flux-density starting out; *illumination* and *irradiation* to flux density arriving.

From the source (light or x-ray) we usually have radiation in all directions. At the receiver light may be in parallel (or diverging or converging) rays or may be in many directions (diffuse illumination). So may x-ray at the receiver be in diverging rays or diffusely in many directions. But in therapeutic radiology irradiation is primarily not diffuse. Since all absorbers also scatter x-ray, therefore there is always added to the flux coming directly from the source a certain amount of secondaries, somewhat altered in spectral composition, which adds to the total flux density (irradiation) at any point. It would be well if this latter were always referred to as *secondary irradiation*. Back-scatter is secondary irradiation at the surface.

I am here suggesting that *irradiation* be used in a narrow sense to mean: (1) the act of applying x-rays to any object, (2) the quantitative aspect of this act, *i.e.*, the roentgen flux density applied. (I think the term "intensity of roentgen rays" had best be abandoned in favor of "irradiation.") *Primary irradiation* would be the roentgen flux density in the beam at a given point, excluding secondaries.

I suppose that the unit suggested (rathion) will ordinarily be used only for primary irradiation, or at least for flux arriving from outside the irradiated object. (In considering questions of protection, all the x-rays reaching the person exposed might be secondaries from the walls of the room, etc.)

- G Inasmuch as "quantity of x-ray," as used in the international definition, means, as we see here, time integral of roentgen flux density, and inasmuch as quantity used in other writings usually means mass or energy total, without the distributional factor, we might well cease using the term "quantity of x-ray" and borrow

instead the word "exposure," which we will now define for x-ray purposes as the time integral of primary irradiation. I am suggesting that secondary irradiation from the irradiated object definitely be not included in the concept of exposure as applied to therapeutic radiology.

- H Time integral of roentgen flux is what we ought to mean by "quantity of x-ray." I am stating this simply in order to persuade doctors not to say "quantity" when they mean "exposure."

- I I think absorption coefficient is a parallel concept to luminosity factor. The relative simplicity of absorption of x-ray energy in air permits us to give it an absolute expression. We are not able, however, so to analyze the action of light on the retina, so must use a merely empirical ratio.

- J Biologic factor consists of three parts: (1) The capacity of the x-ray beam to produce ionization in the material in question (*i.e.*, the roentgen efficiency); (2) The augmentation of primary absorption by scattering. This depends on the geometry of the body irradiated as well as on the spectral composition of the beam; (3) Possible unequal effect from absorption of equal energies at differing wave lengths. We know that the columnar density of ionization differs for absorption of different wave lengths, and there is already evidence that differences in columnar density of ionization are biologically important.

- K, L An ordinary incandescent lamp radiates as light and heat most of the electrical energy put in. So its efficiency is not very different from the luminous efficiency of its beam. But this is not true of a water-cooled x-ray tube which might radiate only 1 per cent of the power input.

TISSUE DOSE

- M The therapist irradiates the patient to a given total exposure, his measure-

ments of *irradiation* being expressible in *rorthia* and of *exposure* in *roentgens*. These measurements concern ionization in air ("air dose," if one chose to call it that). But what he is aiming to produce is ionization in the flesh of his patient, *i.e.*, *tissue dose*.

Flesh is 800 times as dense as air. An exposure of 1 r, productive of two billion pairs of ions in 1 c.c. of air, will be expected to produce 800 times that ionization in flesh. Moreover, if a large volume is irradiated, scattering will add its effect in producing ionization to swell the total tissue dose to perhaps two trillion pairs of ions per c.c.

Measurements of heating effect and calculations of energy absorbed appear not entirely dependable (140,000 ergs per cm.³ has been given as the tissue dose corresponding to a clinical "erythema dose"). If we adopt the fiction that all this energy was delivered instantaneously, it would raise the temperature of the irradiated volume of flesh about 0.003 degree. We might then record tissue dose in terms of erythema dose, of ergs per c.c., or of (virtual) millidegrees. None of these is at present precise.

Now Taylor (1, 2) has held out hope that we can be given a direct measurement of the ionization produced by x-rays in water, with an accuracy comparable to measurements of ionization in air. We ought, therefore, to consider defining a unit of tissue dose to be based on such direct measurements. We might well choose the same specific ionization as we have in air for the roentgen, namely, 1.615×10^{12} ion pairs per gram.

We must realize that these specific ionizations are not strictly the same. In the phantom (for tissue dose) Taylor will try to count ions appearing in a given small volume. For the roentgen, the requirement is to count ions produced by the absorption of x-ray in an unbounded cm.³ of air. Some

of these ions appear outside the test volume. Let us, therefore, give our unit of tissue dose a distinctive name, say *rhegma*, and write: *One roentgen produces one rhegma only under unique conditions.*

One will need extensive tables, based on phantom measurements, giving for surface and depth the rhegmas per incident roentgen for various qualities, distances, and portal sizes.

SUMMARY

Quantitative concepts have been compared for x-rays and light. New x-ray terms and units are proposed for concepts not heretofore generally recognized. This results in the following definitions:

(1) *Roentgen*: The unit of exposure (time-integral of roentgen flux density). Defined by international agreement.

(2) *Rorthion* (plural, *rorthia*): Proposed unit of irradiation, *i.e.*, of roentgen flux density, one roentgen per second, one kludon per square centimeter, 60 r per min.

(3) *Kludon* (plural, *kludons*): Proposed unit of roentgen flux. One kludon per square centimeter, flowing for one second, gives one roentgen.

(4) *Plem*: Proposed unit of intensity of a roentgen source, one kludon per steradian.

(5) *Aith*: Proposed unit of brightness of a roentgen source (usually apparent brightness of a tube target observed obliquely), one plem per square centimeter.

(6) *Rhegma*: Proposed unit of tissue dose, 1.615×10^{12} pairs of ions per gram.

(7) *Irradiation*: (a) The act of applying x-rays to any object; (b) the roentgen flux density applied (measured in *rorthia*).

Primary irradiation excludes the roentgen flux secondarily scattered or reradiated from the irradiated object.

Secondary irradiation at the surface has sometimes been called "back-scatter."

(8) *Exposure*: Time integral of primary irradiation, measured in roentgens in the beam (at the proposed position of the ob-

ject, but in free air with object far removed).

OF WHAT USE?

To present appearances all this is mostly useful as an exercise in thinking. However, it might make easier the saying of some things.

The economics of water-cooling a therapy tube might be expressed by saying that such a one runs at 3,000 plums (through 0.5 mm. copper), whereas most "air-cooled" deep therapy tubes run at about 500 plums.

Primary irradiation might very nicely be given in ronthia. Coutard has felt it important to treat with not more than about a twentieth ronthion but is interested to investigate American high intensity apparatus at about one ronthion. Total irradiation as it concerns danger to the blood-forming organs (as an indirect measure of total energy absorbed by a patient or employee) might be recorded in kludon-seconds, a less awkward term perhaps than square centimeter roentgens. One might, in treating a patient suffering from Hodgkin's disease, with small doses over large areas give a total of 100,000 kludon-seconds and repeat it twice a week. One would have to guard against carrying this too far, for the usually accepted safe limit, one erythema dose in ten years if integrated for half the body surface is only eight million kludon-seconds. And, of course, the body will not bear this so well if given in months instead of years. I have seen dangerous leukopenia follow six million kludon-seconds administered over ten weeks' interval for cancer metastatic in the bones.

For therapy tubes the size of the focal spot is of little moment, but for roent-

genography a high intensity is valuable only if the focal spot is not made too large. A tube might claim a brightness of 20,000 aith (1 mm. Al filter) at 70 kv. (peak) for exposure times of $1/20$ sec. A line focus tube would double this. A Rotalix tube could claim 300,000 aith under the same circumstances. These are only guesses: we have not made measurements. Also this last paragraph ignores the fact that while our roentgen units concern ionization in air, roentgenography is done by effect on silver bromide.

I think that the use of *roentgens* to record tissue dose as well as incident radiation is productive of ambiguity in thinking and writing. I believe that the adoption of a uniquely named unit for tissue dose, the *rhagma*, is practical and important for clinical records.²

I wish to thank Dr. M. G. Lloyd, of the National Bureau of Standards, for his encouragement and advice in the development and presentation of these ideas. I also owe thanks to Dr. Lauriston Taylor, Mr. E. C. Crittenden, both also of the National Bureau of Standards, Dr. E. W. Martin, Professor of Greek at Stanford University, and Dr. James Allen, Professor of Greek at the University of California.

² At the reading of the paper, Dr. E. Pugno-Vanoni remarked that he had long been interested in the parallel concepts of radiology and illumination and referred to two publications: *L'Elettrotecnica*, 15, 814-817, 1928, and F. Perussia and E. Pugno-Vanoni, *Trattato di Rontgen e di Curie-terapia*, pp. 165-167, Milan, 1934. Although he gave symbols, equations, and dimensions for some of the radiological quantities, he did not suggest names for units.

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AN X-RAY INQUIRY INTO THE GENESIS OF THE CURRENT OF VENOUS BLOOD AND LYMPH¹

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AS a means of explaining the current of venous blood and lymph, x-ray investigation is superior to all other methods, the latter being, as a rule, vitiated by concomitant circumstances of a non-physiologic nature, which always leave doubt as to whether or not the results obtained are in complete agreement with conditions naturally prevailing in the living organism.

X-ray investigations, together with the science of oscillations, so well developed at present, enable us to watch *in vivo et in situ* certain hydrodynamic phenomena of a similar kind, such as those observed by Bjerknes in the surroundings of pulsating (respiring) and oscillating globes in water. Analogous phenomena were found in other objects by Dworak, Guyot, Guthrie, Schellbach, W. van Schaik, and others. Throbbing arteries likewise produce periodical changes of hydrodynamic pressure in their environment, and these changes are the cause of a steadily progressive movement of the fluid contained in neighboring veins and lymphatic vessels. That fluid flows in the direction of negative pressure in the thorax, *i.e.*, of resistance considerably smaller than that existing in the opposite direction on the circumference. The resemblance of the arteries to Bjerknes pulsating globes has been pointed out by the present writer.²

Notwithstanding that, at first blush, the phenomena observable in the environments of arteries and of Bjerknes globes differ in outward appearance, they constitute, nevertheless, one and the same physical phenomenon, and their fundamental identity is revealed by the closer scrutiny of facts.

In this paper we are chiefly concerned with the x-ray investigation of this phe-

nomenon. For the purposes of our inquiry, however, we shall also have to glance at what happens in any part of the body, say in a limb, while the arteries pulsate.

During that pulsation all the exceedingly sensitive veins and lymphatic vessels throughout the limb (by no means only the so-called "accompanying veins") receive on all sides a series of sudden strokes, each of which is scarcely finished before it is followed by the next stroke. Hence arises a constant pressure upon the tender veins and lymphatic vessels, just as the pressure of some gas upon the walls of a vessel is the cumulative effect of the gaseous particles incessantly striking against the walls of the vessel. At every beat of the pulse the limb is suddenly enlarged by the new quantity of blood entering it, as is proved by plethysmography. But as the tissues of the elastic center of the limb are closely joined together, the kinetic energy released by every beat of the pulse is continually transferred to the easily shifted liquid contents of the veins and lymphatic vessels, and owing to the cumulative effect of these moves, which are repeated in rapid succession, that liquid is constantly propelled in the direction of the least resistance, *i.e.*, toward the heart. An additional factor contributing to bring about this result is the circumferential elasticity of all the tissues, including the skin of the limb, which alternately changes in bulk in accordance with the rhythmical rise and fall of pressure caused by the intermittent inflow of arterial blood.

These phenomena, which are also of importance to pathology, can be observed *in vivo et in situ* on the x-ray screen during irradiation, when a contrasting fluid has been introduced into certain canals in the organism. I shall give a few examples of x-ray investigation illustrating the action

¹ Presented before the Fifth International Congress of Radiology, in Chicago, Sept. 13-17, 1937.

² *Strahlentherapie*, 56, 285-297, 1936.

of transmitted pulsation as described in the foregoing paragraph.

The essential facts of this action will be

grasped most easily if we start with a discussion of the simplest instances, such as are accessible to every roentgenologist,



Fig. 1. Model showing transmission of pulsation: the beat of the pulse in the elastic tube A, the artery causes the cross-section of the second tube, V, the vein, immersed in liquid, to be contracted, and, consequently, the contents of the vein to be pressed out in the direction of the least resistance.



Fig. 2. Esophagus deprived of peristalsis, seen during systole of heart. Carcinoma cordiae.

Fig. 3. The same esophagus filmed during diastole of heart. One of a series of films taken at short intervals, while the breath was held, showing the motion of the contrasting substance, a pure liquid, under the influence of the transmitted movements of the esophagus toward the head.

and then gradually extend the rules with which we shall have become acquainted to cases in which the mechanism of the afore-

its environment, can observe a rhythmical shifting of the contrasting fluid, synchronous with the beating of the pulse, in the

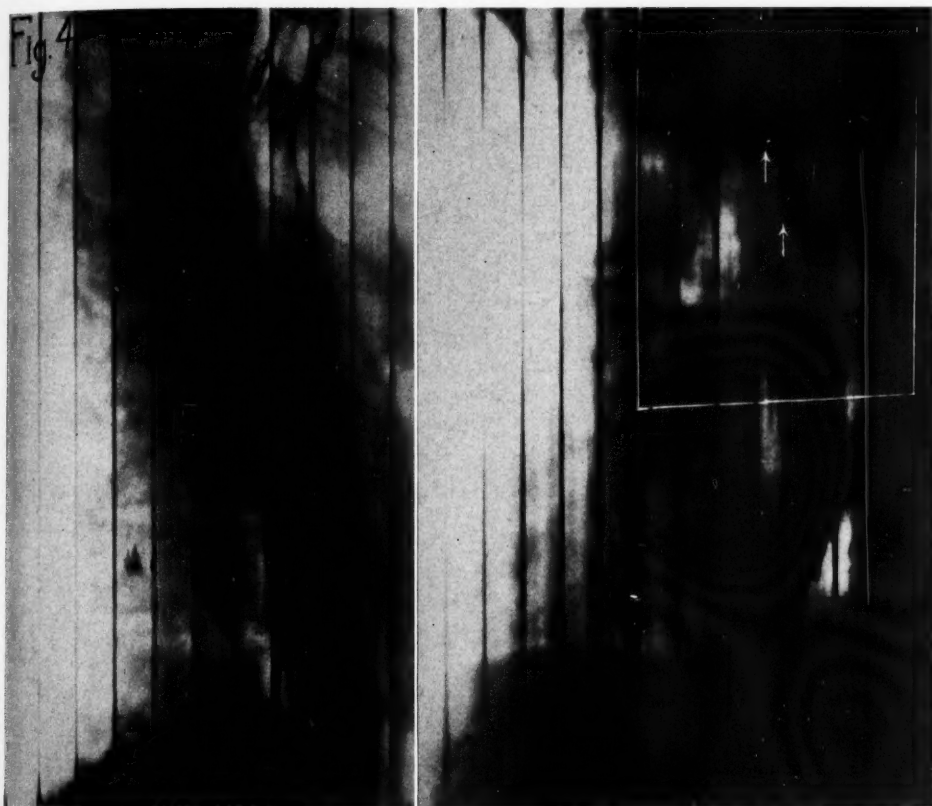


Fig. 4. Another esophagus, in upright position. Influence of cardiac pulsation.

Fig. 5. The same esophagus in the prone position. The transmitted pulsations produce motion in the direction of the least resistance, *i.e.*, toward the head.

said action is neither conspicuous nor even immediately perceptible.

We often see on an x-ray screen transmitted motions of certain elements in a picture of the lungs, the esophagus filled with a contrasting fluid, the stomach, the duodenum, and other segments of the entrails. Under favorable conditions, as in esophagi deprived of the peristaltic movements or in cases of cardiac carcinoma, any roentgenologist who takes the pains to notice it and who eliminates all other factors displacing the fluid in the esophagus, leaving only the pulsatory motions of

direction of the least resistance, *i.e.*, toward the mouth. A stream (current) of the contrasting fluid moving rhythmically backward, the motion being synchronous with the pulsatory oscillations of the circumference of the region surrounding the esophagus, can be seen when watching such an esophagus while the patient is prone and holding his breath. Nothing but the pulsation of the region surrounding the esophagus is transmitted to the contrasting liquid, causing it to flow. Even when the patient is in the standing position it can be seen that the contrasting fluid does not

by any means remain motionless above the constricted cardia of the stomach but keeps bobbing up rhythmically, this being

nomena. The current of liquid in the esophagus, as described in the foregoing paragraph, proves that rhythmical oscillations

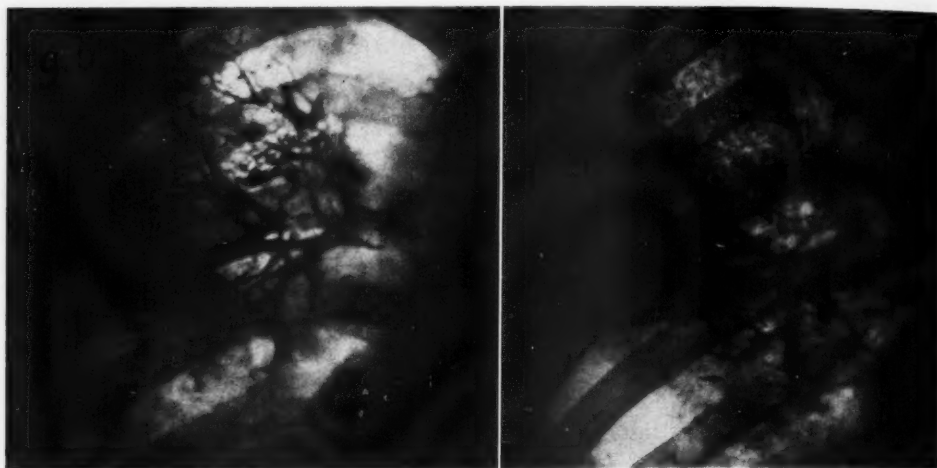


Fig. 6. Control of the motion of the lipiodol filling of the bronchi while the breath is held. The lipiodol is first seen in the foremost parts of the bronchi, before it begins, with the pulsation, to undergo a rhythmical translocation into the bronchioles, as is shown by the next roentgenogram.

Fig. 7. This roentgenogram was taken 20 seconds later than the preceding one. It shows that, while the breath was held, the contrasting mass was intermittently pushed into the bronchioles. The breath was held for 20 seconds. The same position was held continuously.

merely the pulsatory narrowing and widening of the shadow of the esophagus, without the peristaltic movements. Similar phenomena are sometimes observed in perfectly healthy esophagi. It is known that in a sound esophagus too, the contrasting fluid usually remains in the lower region of the esophagus for a certain space of time, longer or shorter as the case may be; and it is during this time that the contrasting fluid becomes noticeable. This mechanism of the displacement of the fluid can also be studied on x-ray films of the esophagus, taken at various intervals of time and in different phases of the action of the heart or aorta.

The phenomena connected with the genesis of the current of liquid contents, whether in the esophagus or in veins, are easily studied only in isolation, but this study enables us to construct a picture of the common cause underlying these phe-

of the dimensions of the circumference *in vivo et in situ*, in the shape of pulsations in the whole environment of any tender and flexible tube in the living organism, are capable of producing in it a continuous current of liquid flowing in one and the same direction.

An excellent proof of this assertion is afforded by the following instance. As is well known, the smaller bronchioles in the lungs have no annular cartilages, and there are other reasons for which these sensitive, thin-walled tubes may be compared to veins with an accuracy sufficient for the purposes of the present argument. The environment of these bronchioles consists of connective tissue, sanguiferous and lymphatic vessels, and nerves.

Since lipiodol in the bronchioles may flow in the direction of the negative pressure of the pleural cavity, conditions are also in this respect comparable to those

in veins. When the bronchi were filled with lipiodol and the breath held, I likewise observed that the contrasting liquid under-

co-ordination of the motions in question directly in blood vessels made visible by means of contrasting fluids, because of the

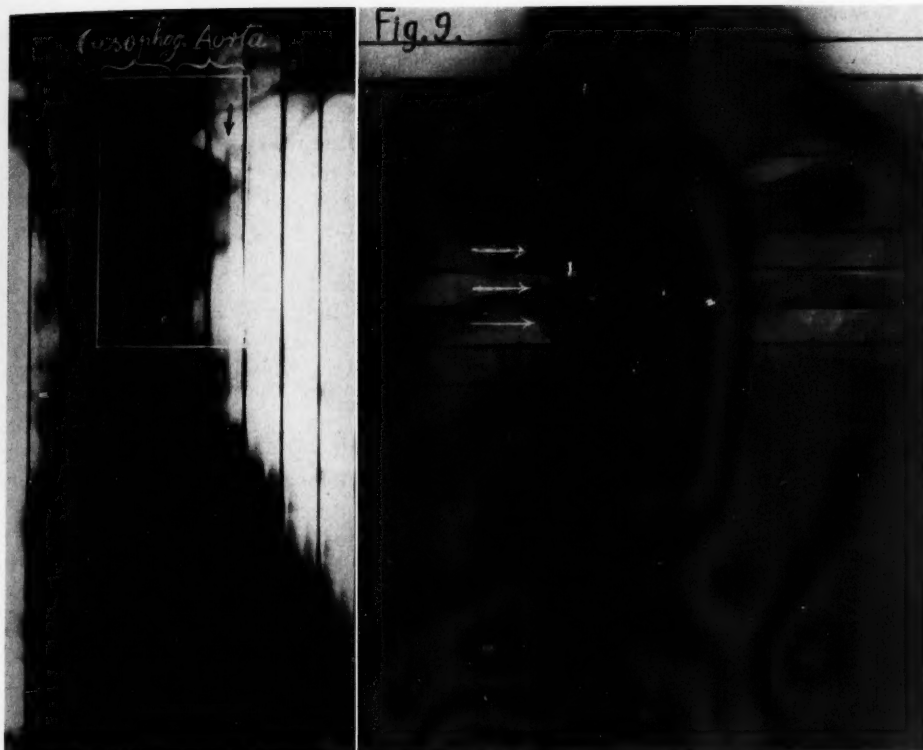


Fig. 8. Kymogram of aorta and esophagus filled with contrasting substance in a horizontal position, the breath being held. Passive translocation of contrasting liquid toward the head owing to transmitted pulsation movements of the esophagus. Film reveals very large and sharp indentations. The movements of the contrasting liquid are of a mixed character, and the part borne in them by the *current* of the liquid is indicated.

Fig. 9. Kymogram of the vena cava superior. Light and dark stripes can be seen on it, distinctly visible in the original, being the expression of the alternating changes in the volume of the environment and of the vein. No cardiac suction is needed to produce these changes, as is proved by the following experiment: From the cut vena femoralis of the hyperemized leg of an animal, *venous blood flows out, with distinctly noticeable pulsation*, merely because of the oscillations, enhanced by the arterial hyperemia, in the volume of the whole leg.

went, simultaneously with every pulse of the environment, rhythmical shiftings toward the circumference, *i.e.*, steadily onward in the direction of the least resistance (Donders' pressure). This stream of the contrasting liquid due to the influence of transmitted pulsation is observable both in the distant parts at the periphery of the lungs (the upper dexter lobe) and in the vicinity of the heart.

Although it is difficult to investigate the

rapidity and small amplitude of these motions, nevertheless, valuable services may be rendered here by short-time x-ray photographs or snapshots, x-ray kinematography, radiokymography, and densography. By these aids we are enabled to examine not only the action of the rapid oscillations of the volume in the shape of ordinary pulsation but also the action upon the current of venous blood and lymph of slow changes in the volume of the sur-

rounding tissues, changes due to various psychic states, chemical substances, irritations of certain tiny branches of the

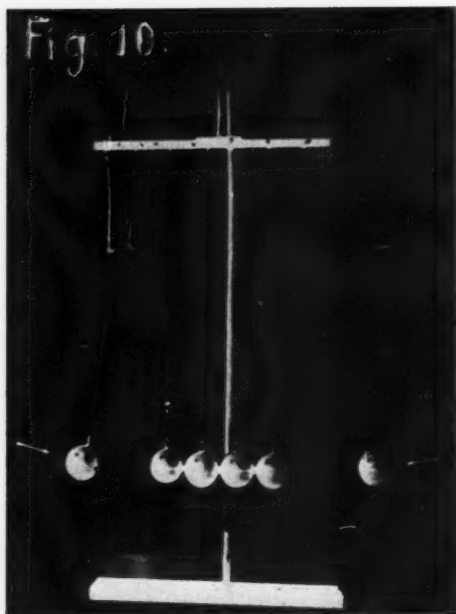


Fig. 10. Transmission of impetus: at the moment when the first ball, 1, strikes against a row of balls, its entire kinetic energy is imparted to the last ball, while the other balls do not move. The first ball, 1, may be taken to represent, for the sake of our argument, the pulsating arterial blood, the last ball, 6, the venous blood, and the intervening balls, the layers of tissue between those liquids.

nervous system, varying states of the pneumothorax, etc. Lastly, I have made use in my experiments, of tissue infiltration over an area varying *ad libitum* by means of inter-tissue injections of contrasting compounds. The technic of such injections of contrasting chemicals was substantially the same as that of C. L. Schleich's method of local anesthesia. Circumferential oscillations, *e.g.*, of a limb, can be modified in various ways, especially by a greater or lesser amount of pressure upon the arteries carrying the blood to the limb.

On the basis of my x-ray investigations I have arrived at the following conclusions:

1. The simplest conditions causing the

venous blood and lymph to pass from the periphery to the heart exist in the small bone ducts with blood vessels running through them. As the *arteria nutricia* and the vein, both immersed in lymph, run along the inside of the stiff-walled bone ducts, the sudden influx of arterial blood at every beat of the pulse distends the lymphatic liquid surrounding the artery. At the same time the vein also experiences over the entire surface of its tender wall, a stroke or sudden compression through the medium of the lymph, in consequence whereof the venous blood and lymph are propelled, at every beat of the pulse, exclusively in the direction of the least resistance, *i.e.*, toward the heart; and this again entails a fresh influx of venous blood and lymph from the circumference. Hence it follows that, in the last instance, the force moving the venous blood and lymph in the vascular ducts of all the bones is the same pressure of liquid as that operating in accordance with Archimedes' law. The system of bones is one of the two principal component parts of the body; hence the above-mentioned force is the proper cause of the current of venous blood and lymph in a considerable part of the human organism.

2. Analogous conditions prevail in other parts of the body. With every beat of the pulse the suddenly growing pressure produces greater rigidity (hardness) in the whole region surrounding all the venous and lymphatic vessels, just as in the bone ducts, for these vessels are enclosed not only by tougher and tenser arteries but also by tenser tissues, which are in consequence of their structure less sensitive than the easily shifted liquid contents of the venous and lymphatic vessels.

At every beat of the pulse the sudden shock issuing from the whole surface of the artery is transmitted to the adjacent layers of tissue. This motion is transmitted from layer to layer without producing any movement in them until the last layer is reached. This one does not offer resistance and can move forward without hindrance, being the liquid con-

tents of the venous and lymphatic vessels. This liquid layer, in the shape of venous blood and lymph, is put in *visible* motion in a similar way as the last ball in the well-known physical experiment of a series of elastic balls. If we set the first ball going so that it strikes the next then *this motion is invisibly transmitted from ball to ball*, and only the last of the series, not encountering any resistance, moves forward in a way distinctly perceptible to the

eye. Thus the last ball (the venous blood) acquires the whole energy of the first striking ball (the arterial blood) while the intermediate balls (the tissues dividing the venous blood from the arterial blood) may remain motionless. The final result, in the shape of a flowing current, is great beyond expectation; first, because of the suddenness and rapidity of the strokes, and then, above all, owing to the cumulative effect of the frequently repeated single actions.

A NOTE ON THE USE OF CLINICAL DOSAGE METERS USING A THIMBLE IONIZATION CHAMBER

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IONIZATION instruments used to measure the amount of radiation delivered to a patient may be classified into two groups: (1) those which measure the radiation transmitted through the filter, thus acting as a check on the filter as well as the output of the generator; (2) those whose chambers are placed on the skin of the patient and measure both the incident and the scattered radiation. The first type has an arbitrary scale to measure intensity and must be calibrated to read in roentgens for each individual generator. The second type may be read in roentgens directly.

Obviously the use of either type offers the roentgenologist a feeling of certainty in his ability to control and measure the number of roentgens delivered to his patient. On the other hand, there are certain dis-

advantages associated with both types and it is the purpose of this paper to call attention to some of these disadvantages and the possible inadvisability of their use without definite precautions.

One of the principal disadvantages of type one was illustrated definitely at a recent calibration of a 400,000-volt x-ray generator. This generator was equipped with a small thimble ionization chamber located in the center of the x-ray beam several inches below the filters and connected to the measuring instrument located on the control stand. This instrument served to integrate the amount of radiation and yet by its location was used as a constancy meter. The thimble chamber of the calibrating r meter was placed approximately 50 cm. below the integrating cham-

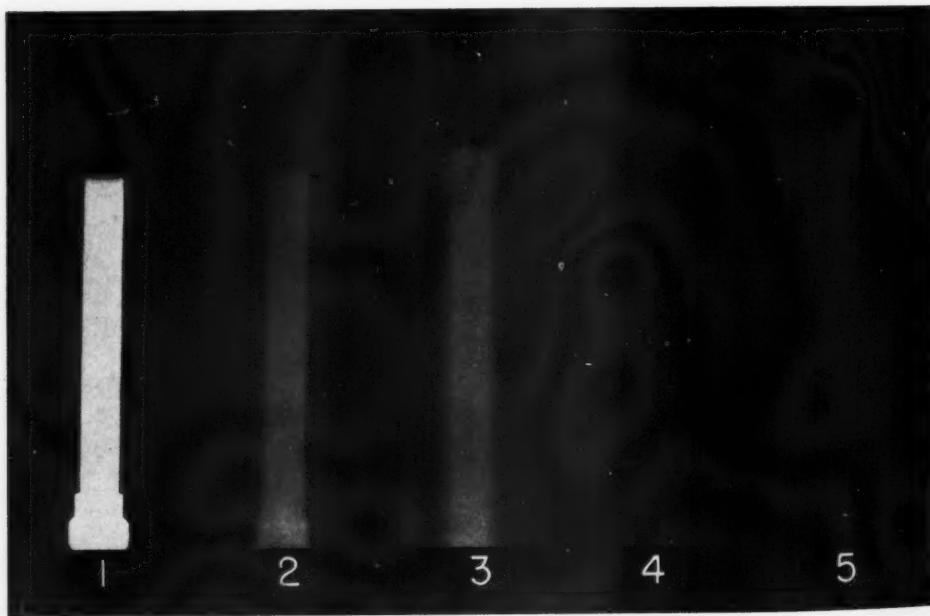


Fig. 1. Shadow cast by a chamber tube in a phantom: 1, at the surface; 2, at 4 cm. depth; 3, at 8 cm. depth; 4, at 12 cm. depth, and 5, at 19 cm. depth.

ber which in turn was 40 cm. from the target. Since the portion of the metallic tubing connecting the ionization chamber with the measuring instrument (so-called chamber tube) was in the beam, it was reasonable to suppose that this metal might cast a shadow. To confirm this belief and determine the amount of absorption in the chamber tube, ionization measurements were made with the integrating chamber in place and again with the chamber removed. There was a difference of 8 per cent in the measurements, or in other words, the integrating chamber tube was casting a shadow detectable at the distance mentioned. In order to confirm this point, additional measurements were made with a thimble ionization chamber smaller in diameter than that of the integrating chamber tube, at distances of 5 and 15 cm. below it. The small chamber was used so as to be completely within the shadow of the integrating chamber. At the distance of 5 cm. there was a 12 per cent absorption and at 15 cm. there was an absorption of 10 per cent by the chamber tube. From these results we conclude that even for hard radiation generated by 400,000 volts the chamber tube casts an appreciable shadow detectable at distances at least as far as 50 cm. below.

In the second group of dosage-measuring instruments in which the ionization chamber and tube are placed directly on the skin of the patient with the chamber itself located in the center of the beam, not only the intensity of the incident radiation is determined but also the maximum amount of back-scattering. However, since the chamber tube is frequently of metal, it follows that here, too, there may be a shadow cast. To determine the existence of this shadow and the depth at which it is determinable, a thimble chamber and chamber tube were placed on the surface of a wood phantom with photographic films in the phantom at various depths, 0, 4, 8, 12, and 19 cm. below the surface. Figure 1 shows the result of a short exposure of this set-up to 200,000-volt x-rays filtered by 0.5 mm. of copper and very definitely indi-

cates that the chamber tube casts an appreciable shadow even to a depth of 19 cm. below the surface of the phantom. The chamber tube may be constructed of organic material instead of metal which would tend to reduce considerably the shadow cast.

Obviously, if the chamber were not centered in the treatment area, but located near the sides or corners of the radiation area, this shadow effect would be negligible. However, it is well known that the intensity of the radiation decreases rapidly at the periphery of the treatment area, the decrease frequently being as much as 20 per cent less than in the center. The placing of the chamber at the edge of the beam might result, therefore, in the center area receiving 20 per cent more radiation than was indicated by the dosage meter.

Another difficulty encountered in placing the thimble chamber on the skin, is the degree of submergence. The ideal arrangement would be to have the chamber one-half submerged, but this is practically impossible at all times and the difference in the reading obtained with the ionization chamber just lying on the skin, as would be the case over a bony structure, and when it is completely submerged, as it may be when treating an abdomen or breast, is approximately 12 per cent. This amount may represent the difference between two areas on the same patient or on different patients, although the dosage meter may show the same reading in both cases.

CONCLUSIONS

This note calls attention to:

1. The existence of a shadow cast when a thimble ionization chamber with a metal chamber tube is placed in the radiation beam either between the filter and the skin or directly on the skin.
2. The variations in intensity when the thimble ionization chamber is placed in the center or at the periphery of the radiation area.
3. The variation in intensity with the degree of submergence of the chamber on the skin surface.

THE ROENTGEN TREATMENT OF LEUKEMIA, WITH REPORT OF A PREGNANCY IN A CASE OF LYMPHATIC LEUKEMIA

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LEUKEMIA was first described in 1845, by Virchow and Hughes Bennett, who independently discovered the disease but did not describe the difference in the cell types. In 1891, Ehrlich described the different cell types which distinguish the myeloid from the leukemoid form of the disease.

Since its discovery, cases of leukemia have been met with in increasing numbers as diagnostic methods have been improved. Various methods of treatment have been used for the relief of this condition. Among the drugs used are arsenicals, Fowler's solution, arsylene "Roche" and arsacetin, iron and benzol, and tuberculin. Vaccines and serums have been used with some success and are advocated by Curschmann (2) and Coley (3). Artificial pyrexia has also been used in its treatment, and transfusions are of great value as a supportive measure. All of these methods have definite value and are still used as supportive measures, especially in locations where roentgen rays are not available. At the present time, roentgen rays are the unquestioned method of choice for the treatment of all forms of leukemia. Contributions to the literature by Sarasin (4), Sgalitzer (5), Langer (6), Leucutia (7), Keith (8), Stewart-Harrison (9), and Golden (10) give various technics of methods used.

Credit for the first treatment of leukemia with roentgen therapy seems to belong to Dr. W. A. Pusey, who reported poor results in the treatment of a case in 1902. In 1903, however, Dr. Nicholas Senn reported treating a case with roentgen rays with good results. Progress in the roentgen therapy of leukemia has been rapid since that time.

Some workers, as Piney and Riach (11) and Arnott and Gloor (12), believe that

best results are obtained by using drugs to support the roentgen rays. We are not in agreement with this, however, as a routine procedure, as it is difficult to estimate the effect of the rays alone on bone marrow, and even more difficult to estimate the effects of x-rays and drugs together.

Our series consists of 47 cases, three of the aleukemic type, 12 of lymphatic, and 32 of myeloid leukemia. Of these cases, 16 (or 34 per cent) are still living, while 31 (or 66 per cent) are dead.

The following statistical data are presented for comparative purposes:

- I. Average age our cases:
 - (a) Aleukemic cases, 23.3 years
 - (b) Leukemic cases, 47.0 years
 - (c) Myeloid cases, 38.3 years
- II. Average duration of illness:
 - (a) Aleukemic cases, 3.3 years
 - (b) Leukemic cases, 2.0 years
 - (c) Myeloid cases, 2.5 years
- III. Average duration of illness before medical aid was sought:
 - (a) Aleukemic cases, 1.5 years
 - (b) Leukemic cases, 10.5 months or 0.88 year
 - (c) Myeloid cases, 1 year
- IV. Average number of treatments:
 - (a) Aleukemic cases, 4
 - (b) Leukemic cases, 8
 - (c) Myeloid cases, 9.

While roentgen rays are the method of choice for the treatment of leukemia, there is some question as to the best manner of using these rays. It is the purpose of this paper to consider the various types and manner of treatment.

Our cases were treated by the local application of the rays, by general radiation, the so-called "spray method," and by a combination of both methods.

The spray method was first used by Dessover in 1905 and revived during the

last few years. From a study of our results, it seems that the spray method is the best form of therapy and this is also the opinion of writers such as Hunter (13), Siciliano (14), and Dale (15).

The dosage varies between 25 to 50 r units, alternating front and back. Daily treatments were usually given to alternate fields until a total of from 100 to 300 r was received, the total dose depending on the white blood count and the general condition. Irradiation was stopped when the white blood count dropped to 40,000 and no irradiation was given by any method when the count reached 20,000.

The spray method seems superior in that there is no roentgen sickness and more of the bone marrow as well as the circulating blood is irradiated. Both of these facts are due, we believe, to the comparatively low dose given at each treatment, the low total dose, thereby necessitating fewer treatments as shown by a table of comparisons. In irradiating a large area, the bone marrow shows rapid response.

Average number of treatments of cases treated by

- (a) Local method, 9
- (b) Spray method, 5
- (c) Both methods, 14.

Patients receiving spray treatments are symptom-free for longer periods of time, as the table indicates. In addition, patients treated by the spray method develop a resistance to the rays very slowly and hence can be carried over a longer period of time.

Finally, the results derived from the spray method are better than the results of local treatment or local and spray combined as the following table clearly shows:

Results of treatment by:

	Percentage Living	Percentage Dead
Local	22	78
Spray	84	16
Both	56	44

It has been suggested that the spray method might cause serious injury to the bone marrow, resulting in aplastic anemia.

We do not feel that there is any such danger from the rays when properly administered by competent radiologists, and autopsy reports such as that of Ogilvie (16) would seem to bear out our belief. If the dose is kept low and frequent blood studies made, it is not difficult to get the blood to a normal level. The spray method is, of course, contra-indicated in the aleukemic form of the disease. We do not feel that the actual life span is increased, but the useful period of life is distinctly prolonged.

The etiology of leukemia being unknown, various theories have been brought forward, notably infection, neoplasm, and hormone disturbances, but none of the theories has been substantiated. Of our 47 cases, 47 per cent gave a history of previous severe infection such as pneumonia, cellulitis, or other acute infections. Practically all the cases gave a history or showed evidence of dental caries, sinusitis, or chronic tonsillitis, but we did not count such infections in determining our figures. The percentages for the different types are as follows:

Aleukemic, 33 per cent
Lymphatic, 20 per cent
Myeloid, 57 per cent.

While these figures are not conclusive, they would seem to lend weight to the infection theory. Curschmann (2) reports two cases of chronic leukemia that showed distinct improvement during the attack of an acute infectious disease. One case had influenza and the other erysipelas. These reports would seem to support the infection theory, as would Coley's reported success with erysipelas serum.

One of our cases of myeloid leukemia became pregnant 16 months after her first x-ray treatment. Leukemia complicating pregnancy is comparatively rare.

CASE REPORT

Mrs. V. S., a 30-year-old white housewife, was first admitted to Duke Hospital on Jan. 19, 1934, complaining of loss of weight for the past eight months and of a mass in her left side of two weeks' duration. Her

general health had been good up to the onset of her present illness. In the Summer of 1933, she began to lose her appetite, whereupon she lost weight and grew steadily weaker. No new symptoms developed until Jan. 4, 1934, at which time she noticed a lump in the left side of her abdomen. The lump was not tender nor painful, but she stated that she felt a sensation of weight. The mass did not seem to increase in size. Careful questioning failed to elicit any history of chills, fever, hemorrhage from the mucous membranes or into the skin. Apparently there had been no systemic reaction other than the loss of weight and progressive weakness.

The essential features of the physical examination on admission were moderate tachycardia and evidence of weight loss. The liver margin could be felt about two fingers below the costal margin on deep inspiration. The liver edge was quite firm but not tender. The spleen was very large, extending to the mid-line and the lower edge disappeared in the left iliac fossa. The margin of the spleen was very sharp, but not nodular nor tender. There was a soft systolic murmur at the apex of the heart, which was accentuated by exercise. The remainder of the physical examination was essentially non-contributory.

Laboratory Studies.—Examination of the blood revealed a red cell count of 3,100,000; hemoglobin 68 per cent; Sahle (10.5 gm.) per 100 c.c. of blood. The white cell count was 160,000 with a marked predominance of lymphoid cells, 38 per cent lymphocytes and lymphoblasts. The red cells were thought to be somewhat pale but otherwise not abnormal. No nucleated red cells were found. The platelets were decreased, the count being 160,000 per c.mm. The basal metabolism was plus 28. Urine and stool examinations were entirely negative.

During this admission, the patient received three roentgen-ray treatments of 180 r each to the spleen on three successive days. On Jan. 24, 1934, five days after admission, the patient stated that she felt much better and refused to stay longer.

She left the hospital that day with a white blood count of 175,000.

Her follow-up was as follows:

She returned Feb. 23, 1934, stating she felt much stronger and that the mass in the left side of her abdomen was smaller. Examination showed the liver to be of the same size as on discharge, but the spleen could be felt 6 cm. below the costal margin in the left anterior axillary line. Her white blood count was 26,000 and no x-ray therapy was given.

On April 12, 1934, she returned and the liver and spleen were not palpable. White blood count was 9,850. No x-ray was given. She continued about the same for a period of six months.

On Oct. 24, 1934, she was feeling well and had gained weight. The liver and spleen were not palpable. The white blood count was 14,400. No x-ray was given. She continued well until April 2, 1935, when she returned with former symptoms. The liver was palpable 3 cm. below the costal margin and the edge of the spleen was 5 cm. below the costal margin. A mass was present in the lower abdomen, which on bimanual examination was found to be an enlarged uterus. No hemorrhage was present in the eye grounds, skin, or mucous membranes.

Laboratory Studies.—Examination of the blood revealed the red cell count to be 3,380,000; hemoglobin 74 per cent; Sahle, 11.5 gm. per 100 c.c. of blood. The white count was 34,000. No differential was reported. The platelet count was 420,000 by the method of Rees and Ecker.

Because of the patient's general condition, the pregnancy was interrupted. The patient stayed in the hospital for ten days and was discharged on April 12, 1935, with a white count of 21,600. On the day before discharge, she was given 100 r to the spleen.

While in our case, it was thought advisable to end the pregnancy, there are cases on record, as those reported by Langer (6) and Kaplan and Connery (17), in which the pregnancy was allowed to go to term and a normal infant delivered.

Oct. 19, 1935, she returned complaining

of weakness and loss of weight. The liver was not palpable. The spleen was 4 cm. below the costal margin. The white blood count was 90,000. Therapy consisting of 200 r units was given locally over the spleen. The patient continued well until Aug. 27, 1936, when the white count was 90,000. She was given 100 r to the front

of the body by the spray method and the next day another 100 r to the posterior surface of the body. She showed much improvement and was able to do her housework. In January, 1937, the white cell count had risen to 33,850 and another 100 r units was given to the anterior body surface. Since that time, the patient has

CHART I

Case No.	History No.	Age	Onset	Admission	Last Visit	Duration of Illness	High Count	Low Count	No. Treatments	Result
Aleukemic										
1	1780	33	6 mos.	11/12/30	2/16/35	4 yrs. 8 mos.	5,400	1,270	3	Died
2	15215	23	4 yrs.	6/14/32	6/28/32	4 yrs.	1,125	160	3	Died
3	47032	14	2 mos.	12/31/34	3/20/35	5 mos.	23,720	1,920	7	Living
Leukemic										
1	701	31	6 mos.	9/18/30	1/23/31	10 mos.	35,200	5,800	1	Died
2	6983	33	2 mos.	8/9/31	10/14/34	3 yrs.	34,950	20,500	4	Living
3	10813	49	19 mos.	1/25/32	4/10/34	4 yrs.	190,000	185,000	1	Died
4	13347	50	2 yrs.	4/19/32	10/20/32	2½ yrs.	115,000	16,750	10	Died
5	33719	54	3 yrs.	1/18/34	1/26/34	3 yrs.	214,000	164,000	2	Died
6	47021	62	2 mos.	12/26/34	2/18/37	2 yrs.	218,000	4,800	17	Died
7	47033	49	6 mos.	12/31/34	7/6/36	2 yrs.	275,000	29,000	32	Died
8	49376	24	2 mos.	2/23/35	4/23/35	4 mos.	146,000	20,300	5	Died
9	55778	52	6 mos.	7/25/35	8/26/35	7 mos.	158,000	7,000	3	Died
10	59428	82	1 yr.	10/27/35	2/6/37	2 yrs.	162,000	38,000	11	Died
11	63611	52	3 mos.	2/10/36	2/14/36	1 yr.	18,900	3,600	2	Died
12	65312	55	10 mos.	4/3/36	5/28/37	2 yrs.	39,000	7,600	13	Living
Myeloid										
1	2080	60	6 mos.	11/28/30	2/2/31	9 mos.	170,000	39,700	3	Died
2	2766	61	6 mos.	1/13/31	3/17/31	8 mos.	74,000	18,800	10	Living
3	7212	68	1 yr.	8/24/31	2/21/32	1 yr.	294,000	47,000	11	Living
4	10671	63	5 yrs.	1/19/32	4/28/32	5 yrs.	11,600	1,600	2	Died
5	18002	36	5 mos.	9/16/32	10/16/36	4½ yrs.	290,000	24,300	26	Died
6	18919	7	2 days	10/7/32	10/8/32	4 days	84,000	80,000	1	Died
7	19774	55	2 yrs.	10/31/32	11/5/32	2 yrs.	300,000	195,000	1	Died
8	27575	22	1 yr.	7/19/33	11/17/34	2 yrs.	359,000	3,760	25	Died
9	31699	39	2 mos.	11/13/33	4/10/37	4½ yrs.	319,000	6,100	23	Died
10	32209	50	1 yr.	11/29/33	2/9/35	2 yrs.	294,000	182,000	5	Died
11	33662	50	2 yrs.	1/12/34	7/9/34	2½ yrs.	491,000	30,000	8	Living
12	33859	30	8 mos.	1/19/34	7/14/37	4 yrs.	175,000	9,200	16	Living
13	39245	26	1 yr.	6/13/34	6/23/34	1 yr.	125,000	60,000	1	Died
14	40913	33	1 yr.	7/23/34	8/10/34	1 yr.	128,000	50,000	7	Died
15	42934	40	1 yr.	9/7/34	6/27/37	4 yrs.	409,000	9,700	36	Died
16	45411	49	1 yr.	11/5/34	8/24/36	3 yrs.	330,000	10,900	7	Living
17	46809	22	4 yrs.	12/9/34	2/19/35	4 yrs.	150,000	9,000	5	Died
18	48067	54	8 mos.	2/5/35	6/24/36	2 yrs.	200,000	18,750	3	Died
19	52364	25	2 yrs.	5/10/35	6/7/35	2 yrs.	46,320	7,220	3	Living
20	54060	16	3 wks.	6/19/35	6/28/35	1 mo.	320,000	1,450	3	Died
21	54455	42	10 mos.	6/27/35	12/12/36	16 mos.	431,000	14,800	22	Died
22	59220	20	13 mos.	10/7/35	7/28/37	3 yrs.	233,200	11,300	10	Died
23	59640	26	22 mos.	10/21/35	12/18/36	1 yr.	190,000	26,360	2	Died
24	60332	30	8 mos.	11/4/35	12/9/36	2 yrs.	380,000	8,500	8	Living
25	61376	19	2 yrs.	12/2/35	9/3/37	4 yrs.	106,000	4,200	4	Living
26	71574	64	11 mos.	8/11/36	4/5/37	1½ yrs.	93,000	3,200	5	Living
27	73615	54	6 mos.	9/21/36	6/17/37	1 yr.	37,000	2,500	3	Living
28	73798	21	1 yr.	10/7/36	6/28/37	2 yrs.	198,000	5,100	6	Living
29	73811	26	16 mos.	9/23/36	9/14/37	2 yrs.	489,000	10,400	6	Living
30	80353	43	10 wks.	2/16/37	3/21/37	3 mos.	135,000	1,950	5	Died
31	83233	41	1 yr.	4/19/37	9/3/37	1 yr.	410,000	48,000	6	Living
32	None	44	6 mos.	8/1/33	9/20/33	1 yr.	135,000	41,600	6	Died

been getting along about the same. At the time of her latest visit, April 2, 1938, her red cell count was 3,355,000 and her white cell count was 32,100. The glands in the left axilla were much enlarged and she was given 250 r units to this area.

This case is reported in detail not only because of the pregnancy occurring during the course of a chronic leukemia, but also because it shows how well these cases can be controlled by roentgen therapy and, in addition, the superiority of the spray method over the local application of the roentgen rays.

SUMMARY AND CONCLUSIONS

Chart I is a summary of our cases.

From a careful study of 47 cases of leukemia, we have concluded:

1. That roentgen rays are the method of choice for the treatment of all forms of leukemia.
2. That the so-called "spray method" is the best manner of applying rays, except for reducing the size of the spleen or the resistant superficial glands.
3. That drugs and other supportive measures should be used only as indicated and not routinely.
4. The question of interruption of pregnancy depends on the patient's general condition, as the full-term birth of a number of normal children have been reported.

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INFLUENCE OF LOW TEMPERATURE ON RECOVERY FROM ROENTGEN RAYS¹

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It is well known that various cells and tissues differ markedly in susceptibility to roentgen radiations; cells in different phases of mitosis as well as tissues in various stages of differentiation show differential responses to their irradiation. The factors which influence and determine this susceptibility are not very well known, but the results of this investigation indicate that the temperature and the metabolic activity of cells after exposure to roentgen rays may be important factors in determining the amount of injury produced, *i.e.*, the effect of a given dose of roentgen rays may be diminished or enhanced according to treatment following irradiation. In this experiment temperature was the factor altered.

The material used was *Ascaris*. Eggs were taken from the anterior one-quarter inch of the uteri of *Ascaris equorum* (mega-locephalia), variety univalens, which had been kept in a refrigerator at 5° C. for not longer than thirty days. Eggs taken from this portion of the uteri were in the pronuclear stage, and developed at a very uniform rate subsequent to being placed at 25° C. All observations were made upon the living eggs by means of an ordinary high power microscope. Eggs were washed free from uterine material, placed in a normal saline solution, and evenly dispersed through the fluid.

After one hour at 25° C. the eggs were divided into control and experimental portions, A and X, respectively. At this time the experimental portion was irradiated at room temperature with a dose of 5,000 roentgens. The roentgen-ray apparatus used was a double cross-arm, mechanically

rectified unit which energized a Coolidge broad focus, universal air-cooled tube at 130 kv.p. and 5 ma. The distance was 25 cm. at which point the dose delivered was about 200 r per minute, as measured in air by means of a Victoreen dosimeter. Eggs were irradiated in a petri dish, 5 cm. in diameter, containing solution from 1 to 2 mm. in depth. The dish was supported by an ordinary roentgenographic table. Since all irradiations were made under exactly the same conditions, no attempt was made to calculate the back-scatter.

Immediately following irradiation, both the control portion A and the experimental portion X were placed at 5° C. and left there continuously throughout the experiment. At the same time that portions A and X were placed at 5° C., a small sample of eggs was taken from each and allowed to remain at 25° C. in order to observe the immediate effects of irradiation upon development. In order to determine whether temperature might in any way alter the effects of irradiation, small samples, both of control and radiated eggs, were removed to 25° C. after intervals varying from three days to six months. Observations upon cleavage were made and recorded hourly during the first 14 hours at 25° C. After one week at 25° C., embryonic development had been completed, and the number of normal and abnormal embryos was recorded. Table I lists the samples observed together with some of the results. $A_{0 \text{ da.}}$ and $X_{0 \text{ da.}}$ indicate samples taken from portions A and X, respectively; subscripts indicate length of time at 5° C. following irradiation.

The above procedure was repeated with three different lots of eggs, taken from the uteri of different worms, and results were found to be essentially the same in each

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case. Each lot contained thousands of eggs, while separate samples observed for development (as listed in Table I) always contained from 500 to 1,000 eggs. During the six months this material was kept at

used as criteria in determining the influence of low temperature on recovery.

(1) *Delay in Cleavage*.—The controls cleave in a very uniform manner. Only about forty-five minutes elapse between

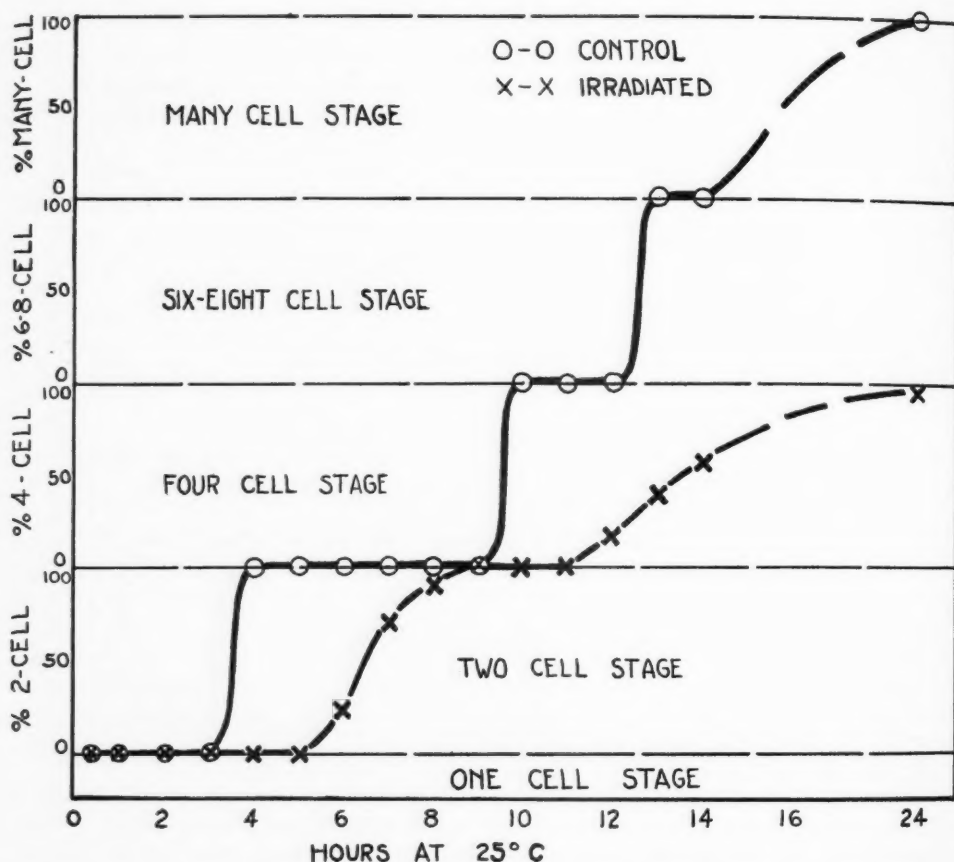


Fig. 1. Cleavage delay resulting from 5,000 r in one-cell stage. Irradiated embryos reach the many-cell stage in about 48 hours. Each O and X represents count made on a sample of from 500 to 1,000 eggs.

5° C. no deleterious effects were noted upon the controls. Samples placed at 25° C. after this interval showed the same rate and uniformity of development as was shown by the first sample.

The effect of 5,000 roentgens upon *Ascaris* eggs manifests itself in two distinct ways which can readily be observed by following their development under a microscope. These two irradiation effects were

the first appearance of division and the moment when all eggs are in the two-cell stage. However, the irradiated eggs are delayed from two to five hours. Whereas all the controls divide during the fourth hour at 25° C., the irradiated eggs divide during the sixth, seventh, eighth, and ninth hours. This is graphically represented in Figure 1. Subsequent divisions appear to be still further delayed, yet in

no case was there evidence of cell division being completely inhibited. In all the samples removed from 5° C. after various intervals, no change could be observed in rate of cleavage, all samples from the ir-

both control and irradiated groups show a very slow decrease in percentage of normal embryos.

From the data here presented, it is not possible to state whether it is the tempera-

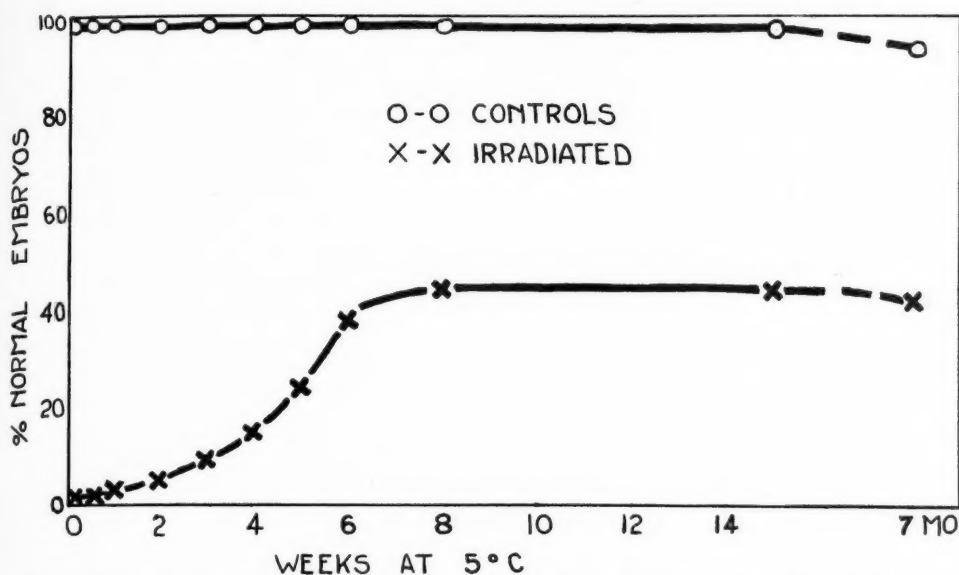


Fig. 2. Percentage normal embryos developing after varying intervals at 5° C. immediately following irradiation. Symbols represent same number as in Figure 1.

radiated group showing the same delay as represented in Figure 1. In other words, no recovery in cleavage delay resulting from irradiation was observed.

(2) *Development of Abnormal Embryos.*—After developing one week at 25° C., at least 98 per cent of the controls are in the normal-coiled embryo stage. Irradiated eggs show only from 1 to 2 per cent normal embryos; the remaining ones are abnormal, consisting of unorganized clumps of cells. However, the number of normal embryos appearing in irradiated samples increased with the length of time they had been kept at 5° C. following exposure to roentgen rays. This is shown in Figure 2. From this graph it can be seen that the maximum recovery seems to be reached in about eight weeks, after which no significant change is noted until about seven months at 5° C. After seven months,

ture factor (cold) or the inactive state resulting from cold which is the determining factor in lessening the amount of injury produced by radiations.

Experiments by Clark (1) would indicate that temperature may be the more important factor. There are also experiments in which heat is used to increase the effect of roentgen rays (2).

However, the metabolic activity of cells may also be an important factor. Strangeways and Fell (3), using tissues of embryonic fowl, found that in irradiated embryos "the degenerative changes produced in tissues by the indirect action of x-rays were greatly delayed, if not completely arrested, by maintaining the irradiated embryo at a low temperature after exposure and thus inhibiting metabolism." They conclude, therefore, that "the degenerative changes induced in tissues of six-

day embryos by x-rays are intimately related to cell metabolism, since they are inhibited or greatly retarded when metabolism is arrested by low temperature."

Ancel and Vintemberger (4), performing

cell division is checked." In his summary he states: "The activity of cells after exposure is a factor in determining the amount of injury produced."

This same idea is expressed by Evans

TABLE I.—SAMPLES PLACED AT 25° C. AFTER VARYING INTERVALS AT 5° C. FOLLOWING IRRADIATION

Samples	Description	Time at 5° C. Following Irradiation	Delay in First Cleavage	Percentage Normal Embryos Developing
A ₀ da.	Control	0 days	.....	99 ± 1 per cent
X ₀ da.	Irradiated	0 days	2-5 hours	2 per cent
A ₃ days	Control	3 days	.....	99 ± 1 per cent
X ₃ days	Irradiated	3 days	2-5 hours	3 per cent
A ₁ wk.	Control	1 week	.....	99 ± 1 per cent
X ₁ wk.	Irradiated	1 week	2-5 hours	4 per cent
A ₂ wks.	Control	2 weeks	.....	99 ± 1 per cent
X ₂ wks.	Irradiated	2 weeks	2-5 hours	6 per cent
A ₃ wks.	Control	3 weeks	.....	99 ± 1 per cent
X ₃ wks.	Irradiated	3 weeks	2-5 hours	10 per cent
A ₄ wks.	Control	4 weeks	.....	99 ± 1 per cent
X ₄ wks.	Irradiated	4 weeks	2-5 hours	15 per cent
A ₅ wks.	Control	5 weeks	.....	99 ± 1 per cent
X ₅ wks.	Irradiated	5 weeks	2-5 hours	24 per cent
A ₆ wks.	Control	6 weeks	.....	99 ± 1 per cent
X ₆ wks.	Irradiated	6 weeks	2-5 hours	38 per cent
A ₈ wks.	Control	8 weeks	.....	99 ± 1 per cent
X ₈ wks.	Irradiated	8 weeks	2-5 hours	45 per cent
A ₁₅ wks.	Control	15 weeks	.....	99 ± 1 per cent
X ₁₅ wks.	Irradiated	15 weeks	2-5 hours	44 per cent

similar type experiments, obtain similar results. These authors believe, however, that the actual amount of injury was the same in both lots, but that in the cold-treated lots it did not develop; that is, the latent period was greatly lengthened. At high temperatures when cell division was stimulated, this period was short. This is somewhat different from the opinion of Strangeways and Fell, who state that if division rate of the irradiated cells is kept at a low level after exposure, the injury not only fails to develop, but actually disappears.

Packard (5), using *Drosophila* eggs, suggests a relation between division rate and radiosensitivity. When cell division is encouraged by high temperature, the effect of irradiation is definitely injurious. "On the other hand, if by cold cells are prevented from dividing, they have a chance to recover. Apparently the reparative processes are favored by low temperatures, that is, they proceed more readily when

(6) when he states that, "in the case of the grasshopper eggs it appears that radiosensitivity, as measured by later development, was not so much a matter of the developmental condition of the embryo at the time of the irradiation as it was of the activity of the organism immediately following irradiation."

In the present experiment, the recovery from roentgen-ray injury occurs at 5° C., at which temperature there is no cleavage and metabolism must be at a minimum. This suggests the possibility that recovery (lessening of injury) may proceed in the absence of appreciable metabolism. However, it must not be confused with recovery in the sense of replacing dead cells with living ones. The recovery discussed here occurs very slowly and must take place within the living cell which is suffering from irradiation effects. In instances in which cleavage is allowed to proceed, there is not sufficient time for recovery to occur before the injury becomes permanently in-

corporated in daughter cells. However, when cleavage is inhibited by cold, partial or complete recovery may take place before development proceeds, thus resulting in a higher percentage of normal embryos.

In this connection the question arises, would recovery occur if cell division were inhibited by other agents, such as lack of oxygen, or is it also necessary to maintain a low temperature to prevent the heat changes suggested by Clark? This problem, together with the determination of a temperature coefficient of the "restorative" process, is now being investigated by the author.

SUMMARY

1. One-cell *Ascaris* eggs, when allowed to develop at 25° C. immediately after exposure to a dose of 5,000 r, showed only 1 to 2 per cent normal embryos, whereas eggs receiving the same dose, and placed at 5° C. for eight weeks, developed approximately 45 per cent normal embryos when returned to 25° C. This would indicate a significant influence of low temperature upon recovery from irradiation effects. Obviously, the embryos, both normal and abnormal, are a measure of irradiation effects upon cell division as well as upon cell differentiation. However, in this paper no attempt was made to separate the two.

2. Although it is quite evident from the

results of these experiments that recovery did occur, the delay in cleavage caused by a dose of 5,000 r was the same throughout the experiment and showed no evidence of being influenced by low temperature.

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THE TECHNIC OF X-RAY TREATMENT OF OPERABLE CANCER OF THE BREAST BASED UPON AN ANALYSIS OF KEYNES' RADIUM TECHNIC

By J. ROBERT ANDREWS, M.D., *Cleveland, Ohio*

It has been shown by Keynes (5) that survival rates equivalent to those obtainable by radical surgical methods can be obtained by radiological methods in the treatment of primary, operable

An analysis of Keynes' interstitial radiation technic in terms of the roentgen may serve, in lieu of statistical survival data, to place the technic of x-ray treatment of cancer of the breast upon a more rational basis.

Such an analysis is now valid for the roentgen has been adopted provisionally as the unit of quantity not only for x-rays but also for gamma rays (10). The intensity of radiation in terms of this unit has been found by numerous observers (2, 3, 4, 7, 11, 12) to be in the region of 8.5 roentgens the milligram element hour at a distance of 1 cm. from a point source filtered by 0.5 mm. of platinum. This value, 8.5 r/mg.-hr.-cm., will be used in this analysis. The radium-bearing needles employed by Keynes were constructed of platinum with a wall thickness of 0.5 mm. Pt and no correction for this factor is necessary.

The theory that doses of 200 kv. roentgen and gamma rays, which are equivalent in terms of the physical constant, the roentgen, are equivalent in terms of biological reactions is not accepted by all. It should be emphasized, however, that results published by those who do not accept this theory are not consistent. This applies especially to the value in roentgens of the threshold erythema dose. This dose, as determined by Quimby (9), is 525 r (measured in air) for 200 kv. x-rays filtered by 0.5 mm. Cu and 1.0 mm. Al delivered at the rate of 60 r/min. to a 10×10 cm. field, 50 cm. distant from the tube target. This dose as estimated by Failla (1) for gamma rays is 1,010 r which is considerably higher. If one considers Quimby's (9) tables of millicuries in radon seeds required to deliver specified doses to masses of various diameters, then the results are again different. For example, the millicuries re-

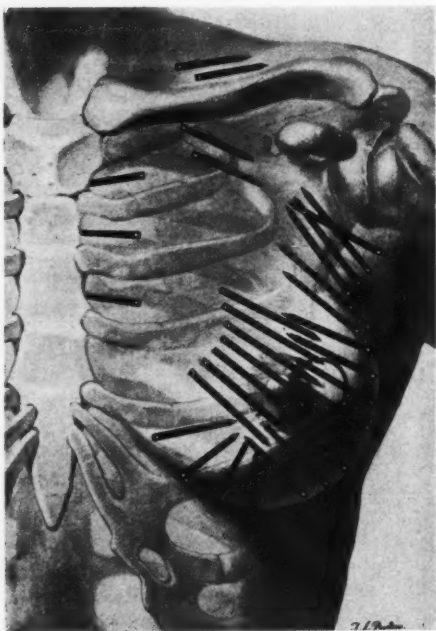


Fig. 1. The usual distribution of radium-bearing needles in a characteristic case of carcinoma of the breast. (Keynes.)

cancer of the breast. This applies, however, only to interstitial radiation and not to external radiation technics. The result is that the present methods of external radiation of cancer of the breast are based largely upon the limitations imposed by the tolerance of normal tissues, especially the skin, rather than upon a more rational basis. This concept of normal tissue tolerance itself cannot, at present, be defined in terms of physical or other constants.

quired to deliver 1 T.E.D. to masses of various diameters is:

d (cm.)	mc./T.E.D.
2	2.9
3	5.4
4	9.0

But the T.E.D. in terms of the roentgen, using the value 8.5 mg.-hr.-cm., will be, for the values listed above:

d (cm.)	mc./T.E.D.	T.E.D. (r)
2	2.9	820
3	5.4	678
4	9.0	636

These values are consistent neither with Failla's value of 1,010 r nor with the in-

fore, valid where such distances are concerned. The gamma-ray doses described above include scattered radiation. The variation between Quimby's data for x-rays and gamma rays becomes less significant if scattered radiation is added to the T.E.D. of 525 r for x-rays. This scattered radiation would be of the order of 30 per cent, and the T.E.D. for 200 kv. roentgen rays, including scattered radiation, would be 682 r, a value even greater than that of 678 r listed in the table for radon at a distance of 3 cm. This latter value of 678 r and the value 636 r for the 4 cm. distance are very much less than Failla's value of 1,010 r but are in general agreement with the value 682 r for 200 kv. x-rays.

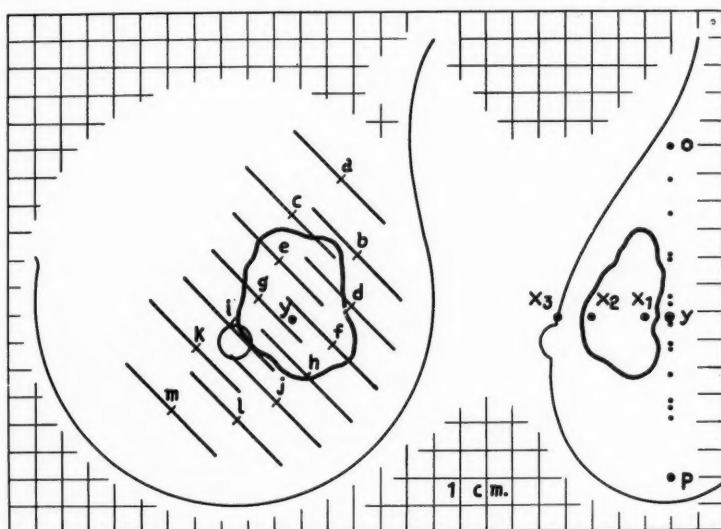


Fig. 2. Diagram of breast containing the actual average number of radium-bearing needles upon which this analysis is based. The needles are considered as point sources. The distance from the center of any needle to any point x can be determined by the law of right-angled triangles. The dose, in terms of the roentgen, at any point x can be determined for each needle. The sum of these doses is

$$\begin{aligned} Dx_1 &= 6,991 \text{ r} \\ Dx_2 &= 3,149 \text{ r} \\ Dx_3 &= 1,988 \text{ r} \end{aligned}$$

(For complete explanation, see text.)

verse square law. This latter is especially significant when it has been shown by Glasser and Rovner (3) that radium sources, even as long as 1 cm., behave as point sources at distances greater than 2 cm., and that the inverse square law is, there-

There is clinical evidence (8) that the biologic effectiveness of 200 kv. roentgen and gamma rays is the same. On the bases of this evidence, and the general agreement of Quimby's threshold erythema doses for x-rays and gamma rays, it is accepted for

the purposes of this analysis that doses of x-rays and gamma rays which are equivalent in terms of the roentgen are also equivalent in their biologic reactions.

The technic of radium-needle implanta-

3 mg. needle in each of its four walls, the needles converging toward the apex of the axilla. The infra and supraclavicular regions are irradiated by placing two 2 mg. needles, of an active length of 3.2

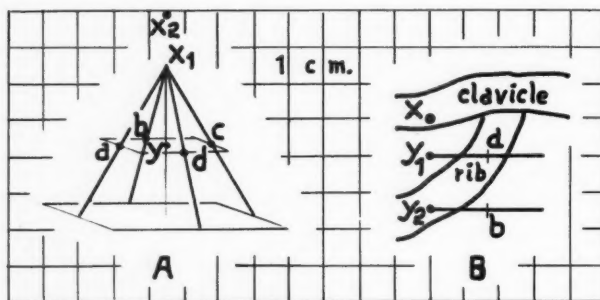


Fig. 3. Diagram showing distribution of radium-bearing needles in the axilla (A). Each needle is considered as a point source (a, b, c, d). The total dose, in the terms of the roentgen, is

$$Dx_1 = 2,975 \text{ r}$$

$$Dx_2 = 1,127 \text{ r.}$$

Diagram showing distribution of radium-bearing needles in the subclavicular region (B). Each needle is considered as a point source (a, b). The dose at point x is

$$Dx = 1,126 \text{ r.}$$

(For complete explanation see text.)

tion in the treatment of cancer of the breast has been described by Keynes in great detail (6). A short review of this technic is necessary. It resolves itself into the treatment of two main areas—the primary growth and breast, and the accessible lymphatic areas. The primary growth and entire mammary gland are irradiated by 3 mg. Ra element needles, of an active length of 4.8 cm. filtered by 0.5 mm. Pt, implanted 1.5 cm. apart in a single plane deep to the mammary gland itself—that is, in the plane of the pectoral fascia. Penetration of the mass itself by the needles is avoided although in thick breasts it sometimes is necessary to employ two layers of needles, one layer lying superficial to the primary tumor. The entire mammary gland is irradiated because of the frequency of "secondary deposits" in the breast itself. No gap of untreated breast is left between the tumor and the anterior fold of the axilla.

The axilla is irradiated by placing one

cm., beneath and two 2 mg. needles above and parallel to the middle third of the clavicle. A similar 2 mg. needle is placed in each of the upper four parasternal intercostal spaces. The great infrequency of metastases in the parasternal intercostal spaces justifies the elimination of this last procedure as a routine one and the presence of palpable nodules in the supraclavicular region would place such a case in the inoperable group, and, therefore, outside the scope of this paper. The irradiation of the primary tumor, the breast, the pectoral fold, and the axilla only will, therefore, be considered as within the scope of this analysis.

Figure 1, from Keynes, shows the usual distribution of radium-bearing needles in a characteristic case.

The individual technic employed in the treatment of 171 patients is described by Keynes (6). Ninety-nine of this group of 171 were found to conform to each other in each of the following standards:

1. Both the breast and lymph areas were treated.
2. The treatment time was 168 hours.
3. Treated not more than once.

This group of 99, rather than Keynes' diagram, was used in order to determine what the actual average dose was. This average dose was found to be different from that shown in the schematic diagram (Fig. 1). The average dose in the breast was found to be 39 mg. \times 168 hours which is equivalent to 3 mg. (the standard needle) \times 13 (number of needles) \times 168 = 6,552 mg.-hr. The average dose in the lymph areas was found to be 27 mg. \times 168 hours, which is practically equivalent to the technic shown in Figure 1, that is:

Region	No. needles	mg./needle	Total amt. (mg.)
Axilla	4	3	12
Infraclavicular	2	2	4
Supraclavicular	2	2	4
Intercostal spaces	4	2	8
			<hr/> 28

In the analysis of this technic in terms of the roentgen the average dose of radium administered to the breast of average size will be that stated above, *i.e.*, $3 \times 13 \times 168 = 6,552$ mg.-hr. The average dose administered to the axilla will be (including axilla and infraclavicular region) 16 mg. \times 168 = 2,688 mg.-hr. These doses do not allow for any radium in the pectoral fold as was stressed in the description of the technic. This would tend to make any error in the estimation of doses in roentgens to the breast and lymph areas in the direction of a greater dose than may actually be the case. The analysis should, therefore, be even more valid.

A diagram (Fig. 2) of a breast 15 cm. in diameter and about five centimeters in thickness was drawn and a tumor mass was sketched in. The average number, 13, of 3 mg. needles was drawn in. These needles are in the positions recommended by Keynes, that is, 1.5 cm. apart, with some overlapping of the point ends, in the plane of the pectoral fascia. These needles are labeled *a, b, c, ... m*; *o-p* is the plane

of the pectoral fascia in which the needles are deposited; x_1, x_2 , and x_3 are points within or on the surface of the breast, and y lies perpendicularly beneath x in the plane of the pectoral fascia.

Employing the value 8.5 r for the intensity of radiation, the mg.-hr. at a distance of 1 cm. from a 0.5 mm. Pt filtered point source then the intensity, I , at any distance, r , is

$$I_r = \frac{8.5}{r^2}$$

and the dose, D , in roentgens for a 3 mg. needle in 168 hours at any distance, r , is

$$D_r = \frac{8.5 \times 3 \times 168}{r^2} = \frac{4284}{r^2}$$

The needles are considered as point sources, the points being located at the center of each needle.

Referring to Figure 2:

$$r^2 = (ax)^2 + (bx)^2 + (cx)^2 + \dots (mx)^2$$

and

$$(ax)^2 = (xy)^2 + (ay)^2$$

$$(bx)^2 = (xy)^2 + (by)^2$$

$$(cx)^2 = (xy)^2 + (cy)^2, \text{ etc.}$$

The total dose in roentgens at any point, x , in the breast for the 13, 3 mg. needles in 168 hours is

$$D_x = \frac{4284}{(xy)^2 + (ay)^2} + \frac{4284}{(xy)^2 + (by)^2} + \frac{4284}{(xy)^2 + (cy)^2} + \dots + \frac{4284}{(xy)^2 + (my)^2}$$

These values, xy, ay, by , etc., were determined by actual measurement¹ on the enlarged figure using the center of each needle as a point source. No attempt was made to estimate scattered radiation. Using this method the dose at any point can be determined. Under these conditions the doses at points x_1, x_2 , and x_3 are

¹ These values are as follows: $x_1 - y$ 1.0; $x_2 - y$ 3.0; $x_3 - y$ 4.3; $a - y$ 5.5; $b - y$ 3.4; $c - y$ 3.8; $d - y$ 2.3; $e - y$ 2.2; $f - y$ 1.8; $g - y$ 1.5; $h - y$ 2.2; $i - y$ 2.4; $j - y$ 3.1; $k - y$ 3.3; $l - y$ 4.2, and $m - y$ 5.6 cm.

$$D_{z_1} = 6,991 \text{ roentgens}$$

$$D_{z_2} = 3,149 \text{ roentgens}$$

$$D_{z_3} = 1,988 \text{ roentgens.}$$

D_{z_1} is the maximum dose received by the tumor; D_{z_2} is the dose received by the periphery of the tumor, and D_{z_3} is the dose received by the skin. For the purposes of the discussion, D_{z_1} will be considered to be 7,000 r; D_{z_2} , which is about the minimum dose received by the tumor, 3,000 r, and D_{z_3} , 2,000 r.

The determination of dosage in the axilla is a more difficult problem and only an approximation of it can be made. The axilla can be considered as a four-sided pyramid with each wall of the axilla representing one side of the pyramid. A needle in each wall of the axilla will lie along the sides of the pyramid as shown in Figure 3-A. The ends of the needles converge at the apex of the pyramid. If each needle is considered as a point source, the point being at the center of the needle (a, b, c, d), then the dose at the point x_1 , of convergence of the needles, will be

$$D_{x_1} = \frac{4(8.5 \times 3 \times 168)}{r^2} = \frac{17,136}{r^2}$$

and

$$r^2 = (ax_1)^2, (bx_1)^2, \text{ etc.} = (2.4)^2 \text{ cm.}$$

and

$$D_{x_1} = \frac{17,136}{(2.4)^2} = 2,975 \text{ roentgens.}$$

The dose at D_{x_2} , which is only 1.5 cm. higher in the axilla than D_{x_1} , will be about

$$D_{x_2} = \frac{17,136}{(3.9)^2} = 1,127 \text{ roentgens.}$$

Figure 3-B shows the arrangement of needles in the subclavicular region which may be considered the apex of the axilla. The two 2 mg. needles with active lengths of 3.2 cm. are considered as point sources, the points being at a and b . The dose at point x , which is the highest point in the axilla, is

$$D_x = \frac{8.5 \times 2 \times 168}{r^2} = \frac{2,856}{r^2}$$

$$r^2 = (ax)^2, (bx)^2$$

$$(ax)^2 = (xy_1)^2 + (ay_1)^2$$

and

$$(bx)^2 = (xy_2)^2 + (by_2)^2$$

$$D_x = \frac{2,856}{(xy_1)^2 + (ay_1)^2} + \frac{2,856}{(xy_2)^2 + (by_2)^2}$$

$$D_x = 1,126 \text{ roentgens.}$$

In review of the data, then, it is found that the minimum dose to the tumor of the breast is about 3,000 roentgens and the dose to the axilla is between 1,200 roentgens at its apex and 3,000 roentgens near its base. These are the doses, from interstitial irradiation with radium-bearing needles, with which survival rates equal to those obtained by surgical methods have been secured. It would follow, therefore, that the same survival rates might be secured by external irradiation with x-rays provided that equivalent minimal tumor and axillary doses are administered. This, of course, demands further proof but these doses should at least serve as a standard of adequate irradiation.

Such doses can be matched and in some instances even exceeded by external irradiation with the use of cross-fire methods. In the breast shown, which is 15 cm. in diameter, the dose at a point in the center of the breast, 7.5 cm. from the edge, would be 45 per cent³ for 200 kv. x-rays of a quality of 1.0 mm. Cu H.V.L. and a field 11 × 9 cm. In the actual radiation of the breast the organ can, however, be somewhat compressed or the rays so directed that this distance may be considerably shorter and the depth dose, therefore, greater. The depth dose under these conditions can be considered to be 50 per cent.

² $xy_1 = 1 \text{ cm.}$

$xy_2 = 2.5 \text{ cm.}$

$ay_1 = 1.6 \text{ cm.}$

$by_2 = 1.6 \text{ cm.}$

³ Depth doses in this part of the discussion from Quimby's data (9).



Fig. 4. Operable carcinoma of the breast 11 days after x-ray irradiation according to the technic derived from the analysis of Keynes' radium technic. Treatment time: 19 days. Dose: Medial breast port, 12×7 cm. 3,500 r; Lateral breast port, 11×9 cm. 3,750 r; Axillary port, 7 cm. diameter 5,650 r. (All doses as measured in air.)

If the breast can be radiated from both sides and the depth dose in the center of it is 50 per cent then skin doses of 3,000 r at each port are necessary to administer a dose of 3,000 r to the center.

In order to deliver a dose of 3,000 r to a point about five centimeters deep to the skin surface in the axilla through a port 7 cm. in diameter, a dose of about 6,000 r (measured in air) would be necessary, for the depth dose under these conditions is somewhat less than 50 per cent. The dose in the apex of the axilla could be augmented by a small subclavicular field, with a comparable dose, just as radium is used in this region.

It is important to note that the radium treatment was given in eight days but, for comparable doses, the administration of the x-ray irradiation in a period of less



Fig. 5. Photomicrograph of edge of irradiation reaction of the type shown in Figure 4. There is complete destruction of the epidermis and acute and chronic inflammation of the corium.

than 20 days is hardly practically possible. It should be noted also that no account of the scattered radiation has been taken. No account of scattered x-ray radiation has been taken because that for gamma radiation in tissue is not known and no account of it was made in the analysis. The variation in the time factor between the two technics is an undetermined influence. The prolongation of the treatment period with x-ray irradiation may be compensated for by the probability that the dose from external irradiation may actually be greater, for the doses described, than that from interstitial irradiation because the contribution of scattered radiation from 200 kv. x-rays is probably greater than that from gamma rays.

Figure 4 is a case of operable carcinoma (aspiration biopsy) of the left breast 11 days after irradiation. The breast tumor was located in the upper outer quadrant and was 5 cm. in diameter. The breast itself was about 15 cm. in its transverse diameter. There was a hard node 1.5 cm. in diameter in the axilla. The breast and axilla were treated according to the technic derived from this analysis. The duration of treatment was 19 days. Two breast ports, 12×7 cm. on the medial aspect and 11×9 cm. on the lateral aspect, were used. The latter one included some of the pectoral fold and there was slight

overlapping of them. The doses applied to these fields were 3,500 r (measured in air) to the medial and 3,150 r to the lateral field. In addition, 600 r was given through a 7 cm. in diameter port located in the lateral breast field directly over the tumor, making a total dose of 3,750 r to this area.

A single axillary port 7 cm. in diameter, which extended from the anterior to the posterior axillary walls was employed and the total dose to this field was 5,650 r (measured in air). It is considered that this single-port method is a more advantageous one than the multiple-port technic in the irradiation of the axilla because with the latter method the reactions are widespread and occur on the posterior and lateral axillary walls which do not need

to be irradiated. With the single-field method, only the axillary contents themselves are irradiated. The dose at the apex of the axilla can be augmented by irradiating through a small subclavicular port.

The reaction produced by such a technic is very severe, as is shown in Figure 4. It does not, however, exceed normal tissue tolerance, as the damage induced is not irreparable. The reaction is of the type shown in Figure 5 which is a photomicrograph of the edge of an irradiated field. There is complete destruction of the epidermis and acute and chronic inflammation of the corium. Occasional small islands of epidermis are left, as shown in Figure 6, and from these, as well as from the epidermis at the periphery of the reaction, re-



Fig. 6.



Fig. 7.

Fig. 6. Twenty-four days after x-ray irradiation. Small islands of epidermis have been preserved in the medial breast field. Replacement of the epidermis results from the proliferation of these islands as well as from the proliferation of the epidermis at the periphery of the reaction.

Fig. 7. Forty-four days after x-ray irradiation. Reaction healed except at lateral breast and axillary fields, the sites of the largest doses.

placement of the epidermis occurs. No such islands of epidermis are left at the site of the largest doses, that is, immediately over the tumor and in the axilla. Here replacement of this epidermis must take place from the edges.

This type of reaction is painful during the first two weeks of its presence and uncomfortable until healed. An ointment, such as the following,

Ung. Zn. Ox. (20 per cent U.S.P.)	1/
Petrolatum	1/
Metacaine	1/1,000

will control the symptoms but the ointment itself may become irritating with use.

The healing of this kind of reaction is very prolonged. Figure 4 shows the height of the reaction 11 days after the completion of the irradiation, Figure 6 the healing stage at 24 days, and Figure 7 the healing stage at 44 days. Restitution of the epidermis was complete, with the exception of some crusting of the lateral aspect of the breast, at the end of 90 days. The patient is living, without evidence of metastases or recurrence, one year after starting treatment, but the crusting of the breast persists. This period of reaction, until restitution of the epidermis is complete, is a long one of discomfort; the lesions require daily dressings, and the persistence of the reaction tends to discourage the patient. These sequelæ should be compared with the short, ten day, post-operative course after radical mastectomy, during which time the patient is quite comfortable.

It is recognized, of course, that a technic of combined interstitial and external irradiation could be formulated on the basis of the analysis here presented. Such a technic would not be accompanied by such a severe cutaneous reaction and it is conceivable that the distribution of radiation in breast and axilla might be better than with interstitial irradiation alone.

CONCLUSIONS

1. There are, at present, no criteria based upon statistical survival data upon

which to base a concept of adequate dosage in the external irradiation treatment of operable carcinoma of the breast.

2. Keynes' data, based upon the interstitial irradiation of breast cancer, provide such a criterion assuming that a direct comparison in terms of the roentgen can be made.

3. An analysis of Keynes' technic for the irradiation of the breast and axilla, in terms of the roentgen, was made. The minimum dose in the breast was found to be 3,000 r and that in the axilla from 1,200 to 3,000 r.

4. The doses of x-ray necessary to deliver comparable minimal doses to the breast and axilla were found to be at least 3,000 r through each of two lateral breast ports and about 6,000 r through a single port in the axilla. Such radiation, to be comparable, should be delivered within 20 days.

5. A case illustrating this technic is presented. The reaction resulting from such treatment is so severe that the method should be employed in the treatment of operable breast cancer only if there are the strongest contra-indications to a radical mastectomy. The technic can, however, be modified so as to be suitable for any inoperable or recurrent breast cancer problem.

6. If, however, radical mastectomy is not possible and x-ray radiation is employed as the treatment of choice, no radiation technic should be considered adequate which does not deliver, in a short time, a minimum dose of 3,000 roentgens to any point in the breast and axilla.

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THE VALUE OF ROENTGEN EXAMINATION OF THE PARANASAL SINUSES¹

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THE widespread employment of roentgen methods in the examination of paranasal sinus disease suggests that these methods are of considerable practical value. In an effort to determine to what

records were promptly discarded because of inadequate clinical information or inconclusive roentgen findings, leaving the records of 854 patients in which were recorded, in close sequence, definite opinions

TABLE I.—DESCRIPTION OF CASE MATERIAL

Case records reviewed	1,000
Deleted (lack of specific information)	146
Total patient group studied in detail (Clinical statement available in each case)	854
Sex distribution: Female	345
Male	509
Age distribution: Years	
0-9	55
10-19	178
20-29	162
30-39	158
40-49	157
50-59	102
60-69	29
70-79	12
80-89	1

TABLE II.—BASIS FOR EXAMINATION OF SINUSES

Localized or specific symptoms	143
Generalized or non-specific symptoms	554
Combined specific and non-specific symptoms	157
Total	854

extent this assumption is correct, roentgenologic and clinical observations regarding the sinuses have been reviewed in a considerable number of case records. Roentgenologic impressions have been compared with symptoms, physical signs, and, where available, operative findings.

At the University Hospital during the two-year-period ending June 30, 1936, 1,248 patients were referred to the Department of Roentgenology for examination of the paranasal sinuses. This group represents 1.8 per cent of all diagnostic procedures conducted by the Department during the 24-month interval. Records of 1,000 consecutive cases of suspected sinus disease were withdrawn from files for this period. One hundred and forty-six of these

from the Departments of Otolaryngology and Roentgenology.

Patients of both sexes and various ages are represented, as shown in Table I. Some of these patients were referred for roentgen examination of the sinuses because of symptoms directly referable to the upper respiratory tract, others because of less specific symptoms, perhaps explainable on the basis of sinus disease, and still others in which such specific and non-specific symptoms were combined (Table II). The relatively small group referred because of localizing symptoms, such as pain on pressure, rhinorrhea, swollen nasal mucosa, and acute headache is explained by the fact that such signs of acute sinusitis scarcely require confirmatory proof and as a rule quickly disappear as the result of expectant treatment. It is when local symptoms persist beyond the acute stage that the rhinologist is most desirous of roentgen consultation.

At the University of Michigan, routine examination of the paranasal sinuses consists of four projections—Waters, Rhese, vertico-mental, and lateral—recorded with the aid of apparatus especially designed for skull radiography. The Waters and

¹ Read at the Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28-Dec. 2, 1938.

In 15.5 per cent of the cases accepted for this survey operative proof was available (Table IV). These are, of course, selected cases with sound reasons for surgical treatment. Only occasionally were roentgeno-

The roentgenologist's ability to report the exact location of recognizable sinus abnormality is related directly to his ability to visualize at one sitting the entire system of air-containing cells in each indi-

TABLE VI.—FREQUENCY OF VARIOUS ROENTGEN FINDINGS RELATED TO THE 5,978 INDIVIDUAL SINUS CAVITIES IN 854 PATIENTS EXAMINED

	Frontal		Ethmoid		Maxillary		Sphenoid	Percentage of Total
	R	L	R	L	R	L		
Anomaly	14	14	...	...	...	...	2	0.51
Clouding (simple)	98	104	141	138	186	201	81	15.86
Clouding and sclerosis	11	9	2	2	5	5	3	0.62
Clouding and bone destr.	5	6	1	1	5	3	...	0.36
Thickened mucous membrane	65	65	116	118	248	233	91	15.67
Thickened m.m. and sclerosis	2	2	...	...	...	...	...	0.07
Thickened m.m. and polyp	1	1	...	...	14	9	...	0.42
Polyp only	...	...	...	...	7	13	...	0.34
Expansion (tumor)	...	...	2	1	8	3	4	0.31
Fracture	...	...	...	...	4	5	...	0.11
Post-operative defect	2	4	3	5	4	4	2	0.41
Total abnormal	198	205	265	265	481	476	183	34.68
Normal	656	649	589	589	373	378	671	65.32

logic or physical findings in error. In but a single instance did surgical exploration fail to confirm pre-operatively diagnosed disease.

Judged purely as a means of recognizing disease, roentgen methods are to-day accepted as essential in examination of the chest. This is true because many significant intrathoracic lesions yield few, if any, reliable symptoms or signs. The present review supplies no basis for a similar conclusion regarding the value of radiographic procedures in paranasal sinus examination. On the contrary few, if any, instances of sinus disease have been recognized by such measures alone. It is in the matter of determining the location and extent of lesions involving the sinuses, as well as in the matter of adding leading information as to the nature of the disease process known to exist, that roentgenologic examination in this particular field proves its worth.

TABLE VII.—INDIVIDUAL SINUSES EXPLORED IN 132 PATIENTS OPERATED UPON

Unilateral maxillary	62
Bilateral maxillary	26
Unilateral frontal, ethmoid, maxillary, and sphenoid	7
Unilateral ethmoid and maxillary	4
Unilateral frontal	4
Unilateral ethmoid, maxillary, and sphenoid	4
Unilateral ethmoid	3
Bilateral frontal	2
Unilateral frontal and ethmoid	2
Sphenoid	2
Bilateral ethmoid, maxillary, and sphenoid	2
Unilateral frontal, ethmoid, and maxillary	2
Unilateral frontal and maxillary; bilateral ethmoid and sphenoid	2
Bilateral frontal; unilateral ethmoid, maxillary, and sphenoid	2
Bilateral ethmoid and frontal	1
Bilateral ethmoid and unilateral maxillary	1
Bilateral ethmoid and maxillary	1
Unilateral frontal, ethmoid, and sphenoid	1
Unilateral frontal and ethmoid; bilateral maxillary and sphenoid	1
Unilateral frontal; bilateral ethmoid, maxillary, and sphenoid	1
Left ethmoid, right maxillary and sphenoid	1
Unilateral frontal and maxillary; bilateral ethmoid and sphenoid	1

vidual patient. Again it should be emphasized that his ability in this direction is necessarily exceedingly limited unless he is supplied with roentgenograms of fine technical quality. Table V shows clearly the (65.32 per cent) of these sinus chambers were found to present normal appearances from the roentgen viewpoint. Signs of disease, when present, were encountered most frequently in the maxillary antra,

TABLE VIII.—SIGNIFICANCE OF ROENTGEN SIGNS OF SINUS DISEASE
I. "Simple Clouding"

Operative Findings (163 Sinuses)	Frontal		Ethmoid		Maxillary		Sphenoid	Total
	R (6)	L (9)	R (11)	L (22)	R (47)	L (54)	(14)	
Soft Tissues								
Normal					1	1	2	4
Pus	2		3	2	27	26	3	63
Pus and thickened mucous membrane		7	6	14	14	20	6	67
Thickened mucous membrane	1		2		1		2	6
Polypoid mucous membrane	3	2		1	3	5	1	15
Neoplasm, benign						1		1
Neoplasm, malignant				5	1	1		7
Bone								
No statement	4	7	8	16	42	50	13	140
Normal	1		3		2	2	1	9
Osteitis		1		2	3			6
Osteomyelitis	1	1				1		3
Malignant invasion				4		1		5

great variability to be expected in the pattern of sinus involvement and incidentally indicates to what extent the roentgenologist can localize signs of disease.

In each set of sinus roentgenograms a great number of individual air cells may be recognized. The actual number varies in different individuals but in general one may consider that in the case of each patient seven more or less well-defined individual sinuses are available for study. The frontals, the ethmoid groups, and the maxillary antra are easily divided into bilateral pairs, while the individual sphenoid cells can conveniently be considered as one chamber. It may then be considered that 5,978 individual cavities were observed in the course of reporting roentgen findings on the present group of 854 patients. Thus considered, it is found that over one-half

less frequently in the ethmoids, and still less frequently in the frontal and sphenoid sinuses. Table VI records not only the frequency of abnormal findings by sinuses, but also according to the 11 classifications of abnormality recognizable by roentgen methods. By far the most frequent roentgenologic evidence of disease was found to be clouding or non-aeration of a normally transparent sinus cavity or thickening of the mucosal lining of a sinus. All other individual signs of abnormality appeared with frequencies of less than 1 per cent.

"Clouding," as reported by the roentgenologist, is a useful term to indicate loss of air content. Although it is sometimes possible to state with certainty that loss of air content has resulted in a specific instance as the result of the accumulation of fluid, it must always be borne in mind that

tremendous swelling of mucosal lining can result in the complete obliteration of air space; that the sinus may be completely filled with neoplasm, or that, instead of the accumulation of exudate in large

it becomes obvious that several of the already mentioned causes for clouding may coexist and may or may not be individually detectable.

Abnormal roentgenologic findings which

TABLE IX.—SIGNIFICANCE OF ROENTGEN SIGNS OF SINUS DISEASE
II. "Clouding with Bone Destruction"

Operative Findings (13 Sinuses)	Frontal		Ethmoid		Maxillary		Total
	R (3)	L (4)	R (1)	L (1)	R (2)	L (2)	
Soft Tissue							
Normal	1						1
Pus		1					1
Pus and thickened mucous membrane	1	2					3
Polypoid mucous membrane		1					1
Neoplasm, malignant	1		1	1	2	2	7
Bone							
No statement					1		1
Osteomyelitis	2	4					6
Malignant invasion	1		1	1	1	2	6

TABLE X.—SIGNIFICANCE OF ROENTGEN SIGNS OF SINUS DISEASE
III. "Thickened Mucous Membrane Lining"

Operative Findings (37 Sinuses)	Frontal		Ethmoid		Maxillary		Sphenoid	Total
	R (1)	L (2)	R (2)	L (3)	R (16)	L (11)	(2)	
Soft Tissue								
Normal		1			1	1		3
Pus	1			1	6	5		13
Pus and thickened mucous membrane		1	2	2	6	2	2	15
Thickened mucous membrane					1	2		3
Polypoid mucous membrane					2			2
Neoplasm, malignant						1		1
Bone								
No statement	1	2	2	2	13	10	2	32
Normal					1	1		2
Osteitis					1			1
Osteomyelitis				1	1			2

quantities, abnormal fluid content of sinus cavities may represent whole blood. When clouding is particularly dense, it may become quite difficult, indeed, to offer any detailed information other than this fact, and

concern themselves with the status of the bony walls of sinuses are apt to be more characteristic and, therefore, more specific. For example, visible expansion of a sinus is virtually pathognomonic of neoplasm,

and if observed in the absence of visible erosive changes in bone the offending neoplasm is apt to be benign rather than malignant. The positive identification of fracture associated with sinus clouding of

fenestration of the maxillary antra was the most commonly employed surgical procedure. In most instances the surgical procedure did not include all of the individual sinuses considered abnormal by the roent-

TABLE XI.—SIGNIFICANCE OF ROENTGEN SIGNS OF SINUS DISEASE
IV. "Expansion (Neoplasm)"

Operative Findings (11 Sinuses)	Ethmoid	Maxillary		Sphenoid	Total
	R (1)	R (7)	L (2)	(1)	
Soft Tissue					
Neoplasm, benign		2			2
Neoplasm, malignant	1	5	2	1	9
Bone					
No statement		2	1		3
Erosion (benign neoplasm)		2			2
Malignant invasion	1	3	1	1	6

fers reasonable grounds for assuming that the clouding is produced by hemorrhage into the sinus. Bone erosion may be produced by invading neoplasm or spreading osteomyelitis. Developmental anomalies are reported most commonly in the case of the frontal cells where congenital absence may lead to erroneous clinical diagnosis because of faulty transillumination with visible light.

The actual accuracy of roentgen findings as compared with underlying disease can be determined only in the light of operative and pathological findings. As was to be expected, only a fraction of the patient group under consideration was ultimately subjected to surgical treatment, a total of 133 individuals. One patient who was operated upon on the basis of positive physical findings in the absence of roentgenologic confirmation is not included, leaving the observations obtained in the 132 cases which were operated upon for comparison with pre-operative roentgen diagnosis. In Table VII the individual sinus cavities explored are listed, indicating the frequency with which various combinations of cells were opened. As might have been expected, simple puncture and

genologist. Table VIII deals with the actual operative findings obtained as the result of exploration of 163 individual chambers previously reported by the roentgenologist to show "clouding." The operative findings are subdivided into those which deal with soft tissues within the cells, as well as abnormalities of bony walls about the sinuses in cases in which such information was available. The non-specificity of this descriptive term used by the roentgenologist is well reflected in this table, although it will be observed that the presence of pus with or without associated thickening of the mucous membrane is responsible for the finding of "clouding" in the majority of the sinuses explored. In explanation of the discovery of neoplasm in the left ethmoid area in five instances, it must be recalled that neoplasms of the nose or orbit may readily invade ethmoid cells. In six instances sclerosis or osteitis discovered by the surgeon was not recognized radiographically and in three instances previously unrecognized osteomyelitis was encountered. In the five examples of malignant invasion of bone described by the surgeon, four concerned the ethmoid cell walls, obviously

for the roentgenologist a difficult site in which to recognize bone destruction.

"Clouding, with bone destruction," reported in 13 sinuses among the group operated upon, represented invasion by malignant tumor in six instances and osteomyelitis in the same number. All of the latter involved frontal sinuses, which is in keeping with the common site of this condition in relation to sinus disease. The neoplasms were found to be far less selective in the matter of location (Table IX).

Analysis of roentgen evidences of thickened mucous membrane lining in the light of operative proof (Table X) shows that the most frequent cause of this change is inflammatory disease. Only one malignant neoplasm appears in this group. Among the bone changes found at operation, it is interesting to note that there were again three occasions when roentgenology failed to recognize osteitis and osteomyelitis. It is true that these changes occurred in areas difficult to demonstrate roentgenographically.

Roentgenologists consider that expansion of a sinus, associated with clouding, is a characteristic sign of neoplasm. Observations recorded in Table XI, although again based on the findings of few instances, justify continued faith in this diagnostic sign. In all these cases either benign or malignant neoplasm was found, and in the majority of them associated bone changes were described.

The frequency with which other radiographic findings were subjected to proof is scarcely great enough to warrant tabulation. Two frontal sinuses reported as showing roentgen signs of clouding with sclerosis were found at operation to show changes characteristic of chronic suppurative sinusitis. This condition was found in two additional sinuses that had been reported as polypoid hyperplasia of the mucosa upon roentgenologic examination. In one instance a reported solitary polyp was confirmed at operation, and removed.

This review of actual experiences with the radiographic approach to the diagnosis of paranasal sinus disease offers con-

vincing proof that such methods are reliable if the limitations of the procedure are clearly appreciated. Apparently this diagnostic measure is not necessary for the recognition of the existence of sinus disease. It does, however, afford a good means of determining the extent of disease in the paranasal sinuses. Involvement of solitary or multiple sinuses can be recognized and the pattern of involvement can be determined with reasonable accuracy. Minimal changes due to disease processes, occurring particularly in the ethmoid and sphenoid cells, may be overlooked because these structures are disadvantageously situated for perfect visualization under some circumstances. Bone destruction may pass unrecognized in these areas even in first quality roentgenograms. Accurate interpretation of sinus roentgenograms is a painstaking, even difficult, task, although the pathologic signs characteristic of disease are relatively few.

DISCUSSION

LEON J. MENVILLE, M.D. (New Orleans, La.): The splendid contribution that we have just heard by Dr. Johnson has indeed been one of great importance. He has been most thorough in his presentation and because of that reason has left but little for me to say.

We all appreciate the importance of the roentgen ray in the diagnosis of paranasal diseases. He has shown us the various conditions which affect their structures and how they may be diagnosed by means of the roentgen ray. He has also demonstrated most clearly that if the roentgen ray is to be of value in the diagnosis of paranasal sinuses, it is important for the roentgenologist to acquire a knowledge of the anatomy and physiology of these structures and also a clear understanding of the pathology of the numerous conditions which affect the paranasal sinuses. In this manner the roentgenologist will become an efficient consultant, when he can intelligently discuss with the referring physician the result of his examination,

and thus keep the roentgen ray in the hands of the roentgenologist.

It is highly desirable for the roentgenologist, in studying diseases of the paranasal sinuses, to attempt, whenever possible, to procure some of the clinical data regarding the examination of the referring physician, and his provisional diagnosis. With this knowledge the roentgenologist functions in the capacity of a physician and is the one to determine how the examination is to be made. Since he is the one who assumes the responsibility of the x-ray examination, he should be the one to decide the technical factors employed.

We all appreciate the fact, of course, that a cloudy sinus will most often mean fluid or probably some thickening of the mucous membrane. However, we know that there are other conditions which will produce cloudy sinuses and I have in mind tumors of the paranasal sinuses. While it is true, as Dr. Johnson has so well presented, that they are not numerous, many of them grow so slowly that when they are discovered clinically they have progressed very markedly, and while it is to be appreciated that we have not as yet been able to place a microscope at the end of an x-ray tube to study the cellular make-up of tumors, we have been able, in

certain instances, to diagnose types of tumors in the human body as correctly with the roentgen ray as by the tissue microscope.

In regard to the frequency of these tumors of the paranasal sinuses, not very long ago Dr. Geschickter, of the Surgical-Pathological Laboratory of Johns Hopkins University, reported in the *American Journal of Cancer*, a series of 211 such cases, in which 16 were benign epithelial tumors; 130 were malignant epithelial tumors; 37 were benign connective tissue tumors, and 16 were sarcoma, so that we know that these tumors do exist and we should be on the alert and try to detect them as early as possible.

While the x-ray is perhaps not as effective in the early recognition of tumors of the paranasal sinuses as it is in tumors in other parts of the body, I would like to emphasize the importance of considering the possibility of their existence more often and of our being on the lookout for them.

In this regard we will keep roentgenology on a high plane where we know that the roentgen ray will become as indispensable to the otolaryngologist as the stethoscope is to the internist and the scalpel to the surgeon.

THE TREATMENT OF ACUTE AND CHRONIC INFLAMMATORY CONDITIONS BY FRACTIONAL DOSES OF X-RAY¹

By HERMAN A. OSGOOD, A.M., M.D., *Boston, Massachusetts*

THE purpose of this paper is to suggest that in the x-ray treatment of acute infections considerably less radiation may be effective than is generally supposed; that small fractional doses daily or twice daily may be more effective than a single larger dose, and that exacerbations which not infrequently do occur following larger doses may be avoided by dividing the initial dose.

The use of x-radiation in the treatment of infections has been known and advocated for at least ten years. A number of papers by well-known authorities have appeared on the subject. The rationale of treatment and the mode of action of the x-rays have been fairly well established and need not be repeated in detail here.

We may state briefly that following x-ray treatment there is a systemic reaction tending to increase the bacteriolytic and bacteriophagic powers of the circulating blood (1). This reaction may be either in the nature of a general immunization or, more probably, a setting free of the products of the destruction of leukocytes at a site of radiation which may be distant from the lesion. These products are then carried through the blood to the inflammatory focus and there take effect. What takes place when a focus of infection is radiated locally has been described by Desjardins (2), Wintz (3), Manges (4), and many others.

In acute pyogenic infections the infiltration of the leukocytes is the most important factor. Leukocytes are more susceptible to radiation and are the most easily broken down, thereby setting free protective antibodies more quickly than they would become available through natural inflammatory processes. Desjardins (5) states that

the rate of response of the leukocytes to radiation parallels the clinical response. The end-result is a relative alkalization of the tissues. Local blood supply is increased and the increased permeability of the cell wall favors osmotic exchange. But, as Dyes (6) points out, an increased destruction of leukocytes swamps the tissues with albumen bodies (leucines), causing temporarily at least a relative acidosis with the accumulation of more toxins and decomposition products than can be handled; therefore, resistance to the original infection may be lowered and its exacerbation or spread may be favored, or, as Desjardins (7) puts it, a reactive inflammation is superimposed on the original infection.

The optimum therapeutic dose obviously would be that amount of radiation which would destroy sufficient leukocytes to produce the maximum bacteriolytic and bacteriophagic action at the site of the infection without overloading the tissues with toxins, causing too rapid a breakdown of the suppurative process, or otherwise producing an exacerbation or spreading of the original infection. The optimum spacing of this dose would be that which would permit full utilization of the antibodies produced, without the accumulation of an excess. This optimum therapeutic dose is not a constant, but varies with the stage of the inflammatory process, the degree of leukocytic infiltration, the site and extent of the lesion, and the patient's resistive powers.

Treatment of each case must be individualized. In general, the more acute the inflammation the smaller should be the dose (8), and the closer should be the spacing. It has been stated that if a larger than necessary dose (over 200 r) is given, the favorable result is delayed for some "unknown" reason, but no harm is done (9). This may or may not hold for chronic

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inflammatory conditions, but it certainly is not true for acute pyogenic infections. A maximum dose, as previously stated, not only may fail to give favorable results, but, by superimposing the reaction due to the x-ray upon that of the original infection, may actually lead to an exacerbation or spread of the infective process. During the suppurative stage, too precipitate a breaking down is dangerous (10). The result, if the infection is superficial, may be relieved by prompt and adequate surgical drainage, but if it is a pelvic or other deep-seated infection lack of adequate drainage may cause serious complications and possibly death.

Even in sub-acute lesions an exacerbation may follow a comparatively small dose of x-ray. For example, x-ray therapy is frequently used for the treatment of boils and carbuncles: 150 r is the usual dose. A young woman 30 years of age presented, with a pustule on her cheek opposite the left lower second molar. It measured about seven millimeters in diameter. She said she had had it for four or five days. It was well circumscribed, not particularly tender, and showed no signs of coming to a head. Her physician advised x-ray treatment and she was given 150 r over the lesion. Twenty-four hours later the entire side of her face was swollen and the cervical glands on that side were enlarged and tender. The condition ultimately subsided with the application of ice and no further x-ray. During the interval her physician and family were considerably alarmed.

Such exacerbations whereby an apparently indolent lesion is suddenly activated following x-ray treatment are well known to dermatologists. They occur frequently in neurology where x-ray is used for the relief of pain in the neuralgias, sciatica, or over the spinal nerve roots. In asthma such reactions may be extremely dangerous. It should be recognized that similar exacerbations do occur following the x-ray treatment of infections even in doses as small as 150 r.

Our experience leads us to believe that

such reactions can be eliminated by dividing the initial dose into fractions. In acute conditions we use 20 r daily or twice daily; in less acute conditions, 50 r daily to a total not exceeding 250 r. For example, a man of 60 years entered a local community hospital with an acute cellulitis of the face and cheek following infection of the upper lip. Sulphanilamide was tried but failed to give relief. His condition was considered urgent. There was no x-ray therapy equipment in the hospital. A self-rectified radiographic unit was calibrated, using a 1 mm. aluminum filter. He was given 20 r twice daily for two days, then once daily for two more. He began to show improvement on the second day and was discharged well on the seventh day. He had no unpleasant reactions.

A diabetic male of 74 years was referred with furunculosis of the nose. He was given 75 r on each of two consecutive days. Almost immediately following the second treatment, swelling and pain markedly increased. Ultimately the process subsided without recurrence. We believe that if we had divided the initial dose we could have avoided the unpleasant reaction. Williams and Bryan (11) have reported the treatment of 170 cases of acute coryza, using daily doses of 20 r four times: 12 per cent were symptom-free in 24 hours, 56 per cent in 48 hours, and 19 per cent in 72 hours. In cases in which we have used x-ray, our results have paralleled theirs.

X-ray, however, has no prophylactic value against recurrence (12). Because of dangers inherent in the repeated use of x-ray in the treatment of recurrent types of infection, we have, therefore, preferred to use ultra-violet and infra-red or short wave diathermy for the treatment of coryza (13). Daniel (14) recommends fractional doses of from 20 to 40 r every two or three days for the treatment of acute inflammatory conditions of the upper respiratory tract, and from 80 to 100 r in chronic cases. In acute sinusitis, particularly of the antrum, we have used 20 r daily or twice daily, not exceeding a total of 400 r with, on the whole, satisfactory results and no

exacerbations. Most rhinologists do not like to open an acute antrum under three weeks. If results are to be obtained by x-ray, they will be evident in less than one-third of that time. We have had no opportunity to treat acute mastoids, but would like to call attention to the work of Rathbone (15), Lucinian (16), and others.

Many infections respond to as small a single dose as 50 r. Furunculosis of the ear, for example, has shown relief from pain the following day, with subsequent resolution without symptoms. In cellulitis, with painful swelling following the difficult extraction of teeth, particularly third molars, the pain is relieved promptly with this dose and the swelling usually subsides in from 24 to 48 hours, which is considerably quicker than can be expected from the use of conventional methods.

On the other hand, we have seen marked exacerbation with distressing symptoms following an initial dose of 50 r in at least two cases of epidermophytosis.

With the exception of sore throats, we have had comparatively little experience with streptococcus infections. Since the infiltration of leukocytes at the site of streptococcus infections is not a predominant factor, it would appear that we are here more dependent on the anti-infective properties of the circulating blood. Therefore, radiation of the lymphatic tissues (spleen, lymph nodes, etc.) in fractional doses might reasonably be expected to be effective as an adjuvant to local radiation.

We have said comparatively little about chronic infections. At present we are using 50 r two or three times a week, with voltage and filtration depending upon the size of the patient and the depth of the lesion. We do not exceed 400 r per series. If necessary, we may give a second or third series at intervals of two or three weeks: we do not give more. Immediate response in chronic infections is not to be expected (17), but if favorable results are not obtained in a reasonable time (*vide supra*), there is nothing to be gained by giving larger doses or prolonging the series. It is

common experience that tissues which have been subjected to too intense or too protracted a series of x-ray or radium treatments are much less resistant to infection. Khreninger (18), by experiments with mice, has shown that sensitivity to infection is proportional to the amount of radiation which the animal has received. Furthermore, the danger of the cumulative effect from repeated small doses should not be lost sight of.

Wintz (19) also mentions the so-called radiofrequency short waves as having possibilities in the treatment of infections. While much that has been written about short waves will have to be discounted, we believe that they have a definite place in radiology. They will apparently accomplish in infections—perhaps in a longer time and with more treatments—fully as much as x-ray, and without the dangers inherent in repeated x-ray exposures. We should prefer short waves for chronic and recurrent infections.

At this point we desire to state most emphatically that the use of the so-called ultra-short waves, meaning thereby the radiofrequency waves of six meters wave length or less, is just as much a part of radiology as x-ray or radium. Their use should not be left in the hands of physiotherapists who, however well trained they may be in baking, massage, corrective exercise, and the like, are neither physicists nor radiologists; and unless they have received special training are not competent to administer this form of radiation intelligently. It should be recognized that the misuse or abuse of this form of radiation can do just as much harm to the patient as the misuse or abuse of x-ray or radium.

In conclusion, we submit that acute infections may be adequately, and perhaps better, treated by small fractional doses, using apparatus of low or medium voltage such as is now available in most of our smaller communities. In case of necessity, even a radiographic unit could be used. We do not, however, intimate that any general practitioner who has an x-ray unit is competent to treat infections. Training,

experience, and accurate calibration of apparatus are, of course, essential.

We make no positive claims for the fractional method at this time. The cases we have reported are selected as typical illustrations. Our series is still too small for statistical evaluation.

We believe this method has possibilities and, therefore, submit this preliminary report for the purpose of recording our own experience and in the hope that it may stimulate further observations and possible confirmation by others.

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DISCUSSION

R. R. NEWELL, M.D. (San Francisco): I was very much interested in what Dr. Osgood had to say. I have tried to conduct some clinical experiments to find out exactly how useful x-ray may be in inflammatory conditions.

What I want to point out is the extraordinary difficulty of evaluating the results of a clinical experiment in the use of a therapeutic agent when the disease we are

treating is one from which most of the patients get well.

We have tried to escape from the difficulty by running a controlled series—treating every one presented with that diagnosis, but using a lead filter to block off the x-ray in alternate cases. In some of those we have ourselves not known which filter was blocked off with lead and which filter let x-ray through, so that neither the patient, the radiologist nor the referring physician could know which patient was getting the x-ray treatment and which was not.

We tried such a series in boils and gave 100 roentgens to the boil on each of three successive days. A number of such patients were treated. We could find practically no difference in the clinical courses of the cases that got x-ray and those which did not get x-ray. Maybe we didn't watch them closely enough.

We are sufficiently interested so we are continuing the clinical experiment and are now giving the boil 300 roentgens in one sitting instead of 100 roentgens each of three successive days. I have the impression, from watching the cases, that there are some that react quite miraculously to the single moderate dose of x-ray treatment. I won't know until we study the series, having seen which were getting x-rays and which were not, whether those miracles were spontaneous on the part of the patient or could be ascribed to the x-ray.

HERMAN A. OSGOOD, M.D. (*closing*): I am very grateful to Dr. Bell for bringing out in his discussion¹ the importance of inflammatory reactions in malignant disease, particularly in mentioning the low rate per minute which, I believe, is extremely important.

Of course, it is difficult to evaluate, as has been stated by the second discussant, any method in which most of our patients recover spontaneously. On the other hand, in colds, for example, the average coryza

¹ Not returned for publication.

runs perhaps for five or seven days. If your patients, in the majority, recover in from twenty-four to forty-eight hours, perhaps we have done something to benefit them.

In the treatment of boils, it depends entirely on what stage you are in. If in the first twenty-four to forty-eight hours, you may get resolution by absorption. If at a later stage, you undoubtedly do hasten suppuration. It is my impression (but here again I do not wish to be too definite) that

the larger dose in boils which are about to suppurate does very definitely break them down more rapidly and the surgeon should be available for incision and drainage.

In fluoroscopic work the danger of giving doses which may be large if held over one area is of considerable importance.

I might state in closing that I know of one case in which there was a very marked exacerbation of epidermophytosis from the examination by x-ray incidental to the fitting of a shoe.

THE DENSITY OF THE CENTRAL SHADOW IN THE DIAGNOSIS OF INTRATHORACIC LESIONS¹

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JUST as there are areas in the lungs silent to auscultation, so there are certain portions of the lung-fields relatively invisible to roentgen exploration. The conception that those areas of the lungs and pleura which are superimposed upon by the denser shadows of the heart and other mediastinal structures, the diaphragms and subdiaphragmatic organs, and even by the ribs, are not entirely amenable to roentgen study, has been partially responsible for the use of the stereoscopic, lateral, and oblique projections. To some extent, the introduction of bronchography served to make roentgen observation of certain sections of the lungs more successful. Nevertheless, the possibility that lesions may be present in the lung which are not visible in the roentgenogram, because they are hidden by the central shadow, is always to be considered.

It is significant that in many textbooks on roentgen diagnosis the diagrammatic representations of roentgenograms of the thorax portray the cardiac area as a blank. The inference from such a representation could be that there is no lung behind the heart or that this portion of the lung cannot be examined roentgenographically: obviously the latter is meant. But experienced roentgenologists frequently are able to detect lesions of the lungs or pleura, which manifest themselves within the cardiac shadow, by the observation of changes of density in this shadow. Curiously enough, there is no reference to this point in the various texts on the roentgen diagnosis of intrathoracic lesions. The observation of variations in the density of the central shadow of the thorax, especially of the

relative density of the portions of the cardiac shadow to the right and left of the spine, has been of such assistance to me in the diagnosis of many pleural and pulmonary lesions that the findings are worthy of expatiation. This point is particularly important when anteroposterior or postero-anterior films of the thorax are the only available studies, as is commonly the case in the more acute and severe illnesses necessitating bedside examination.

It should be emphasized that reasonable penetration must be effected in order to bring out variations in the density of the central shadow. If rather soft exposures, such as those generally used for demonstrating minimal pulmonary lesions, particularly early tuberculous infiltrates, are employed, the entire cardiac area does appear as a blank. All the x-rays directed through this area are absorbed by the shadow of the heart itself. Consequently any change in the lung or pleura which would increase the density of the heart will not be recorded. In the type of case to which the signs to be described below are applicable, overexposure is not harmful as the lesions under investigation are generally gross. At the same time the overexposed roentgenogram permits the demonstration of changes of density which may be of great value in elucidating obscure lesions. We have repeatedly seen cases of pneumonia in which the usual type of film taken in the upright position appeared to be negative. On repetition with the patient supine and a heavy exposure, the evidences of consolidation were obtained.

A study of cross-sections of the thorax indicates that the anteroposterior diameter of the normal heart is approximately equal throughout its extent from right to left except in its most caudal portion.

¹ Presented before the Radiological Society of North America at the Twenty-fourth Annual Meeting at Pittsburgh, Nov. 28-Dec. 2, 1938.

Hence the density of the normal cardiac shadow above the level of the diaphragms should be uniform on both sides of the

the descending aorta may appear to the left of the spine, adding an increment of density at this point. Examination of an-

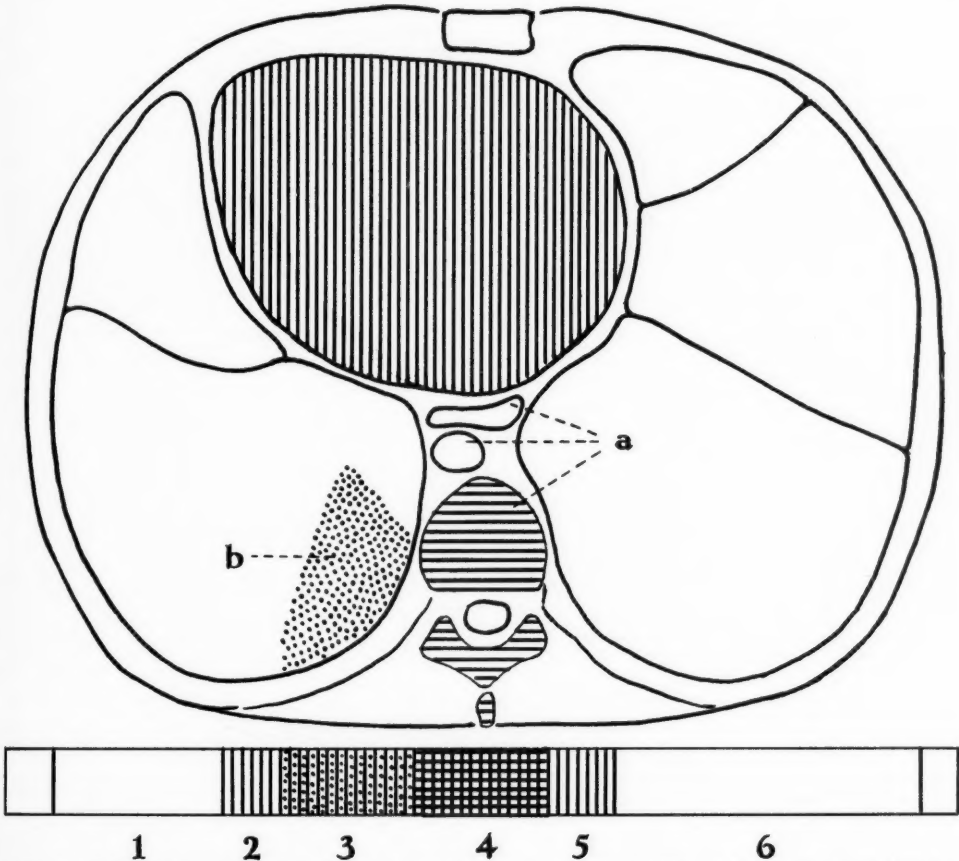


Fig. 1. Schematic representation of cross-section of thorax at the level of the eighth thoracic vertebra in a case of early pneumonia of the left lower lobe. The anteroposterior roentgenogram is shown below. The densities of the cardiac shadow, the spine and mediastinal structures (a), and the consolidation of the lung (b), are all shown by different designs. The projection of these shadows onto the roentgenogram is also recorded by similar designs.

1. Left lung density without superimposition.
2. Normal density of left side of heart.
3. Increased density of left side of heart from superimposition of shadow of consolidation in medial portion of left lower lobe.
4. Increased density of central shadow over spine and large vessels.
5. Normal density of right side of heart (compare with 2).
6. Right lung density without superimposition.

spine. Over the area of the spine the density necessarily is greater because of the superimposed shadow of the sternum, the vertebræ, the large vessels, and other mediastinal structures. In older individuals,

teroposterior or postero-anterior films of the thorax in normals, especially if they are somewhat overexposed, will reveal these uniformities and variations of density of the central shadow. A reference to the dia-

gram illustrated in Figure 1, a cross-section of the thorax at the level of the eighth thoracic vertebra, will indicate graphically the recording of the density of the central thoracic shadow upon the roentgenogram, when an anteroposterior exposure is made. The varying densities are represented on the film by the different types of cross-hatching which correspond to the same design in the structure which is projected upon the roentgenogram. The density of the cardiac shadow is approximately the same to the right of the spine (see 2, Fig. 1) as it is to the left (see 5, Fig. 1), if it is not superimposed upon by any other solid structure. Projection of the vertebrae and other densities in the midline increases the total density of the film at this point (see 4, Fig. 1). Obviously, the density of the base of the heart is somewhat less than that of the more caudal portion. If there is added to the cardiac shadow any additional increment of density such as would occur from a consolidation in the medial portion of the left lower lobe or an effusion in the posterior mediastinal space, an increase in the density of that portion of the cardiac shadow overlying the intrathoracic lesion will result. Such an increment of density is produced in Figure 1 by a triangular area of consolidation of the left lower lobe. The increased density of that portion of the cardiac shadow overlying this area of consolidation is also reproduced on the film (see 3, Fig. 1).

In the early diagnosis of lobar pneumonia, especially of the left lower lobe, a change in density of the central shadow has proved to be a valuable sign. This was casually noted in a paper by Ude (4), but in the voluminous literature on the roentgen diagnosis of pneumonia little attention has been paid to this point. In the earliest stages of the lesion it may, in some cases, be confined to the very medial portion of the lower lobe, so that the cardiac shadow covers the area of consolidation completely. In the case of suspected acute pneumonia, anteroposterior roentgenograms, with the patient supine, are usually made at the bedside. Because of the rela-

tively short focus-film distance the heart shadow is likely to be exaggerated, thus overlapping a much larger area of the lung-field than otherwise. Under such circumstances, the sole evidence of a consolidation may lie in the increased density of the left side of the heart. With this in mind, a careful inspection of the density of the cardiac shadow itself, especially by comparison of the right and left sides, will indicate clearly the presence of the abnormal density in the lower lobe, even if the consolidation does not extend beyond the limits of the cardiac border. The drawings of roentgenograms of the chest shown in Figure 2 illustrate such a case admirably. Figure 2a represents the shadow densities of the normal chest when a heavy exposure is made. In Figure 2b is shown a case of left lower lobar pneumonia. The marked increase in the density of the left side of the heart is shown without any accompanying density in the lung beyond the heart border. A typical roentgenogram of such a case is illustrated in Figure 3. This patient came in for examination less than 24 hours after the onset of the pneumonia. Physical findings over the lungs were practically *nil* at this time. Without the benefit of lateral views a definite diagnosis of left lower lobar pneumonia was readily made from this one roentgenogram. This was abundantly confirmed by the later course of events. We have had a similar experience on many occasions.

The varying densities which may occur with partial consolidation of the left lower lobe are well brought out in Figure 4, an anteroposterior roentgenogram of the thorax in a case of bronchopneumonia superimposed upon bronchiectasis of the left lower lobe. The normal, equal density of the cardiac shadow on both sides of the spine is here illustrated. The increase in density to the left of the spine, due to the descending aorta, is also apparent. The pneumonic consolidation manifests itself as an area of increased density over the apex of the heart and extending into the left lung-field. The contrast in density between the normal heart shadow above and that portion

below which is superimposed upon by the consolidation in the lung is most striking.

It is obvious that lateral views may serve to demonstrate such lesions but these are not always obtainable. The usual routine procedure is to make an anteroposterior view at the bedside. If nothing is observed,

the lateral view may not be undertaken, to avoid further disturbance of the patient. The observation of an increase in the cardiac density may be a sufficient stimulus to prompt a lateral examination, and the diagnosis may thus be confirmed.

While the observation of the increase

Density of the Central Shadow in Lobar Pneumonia

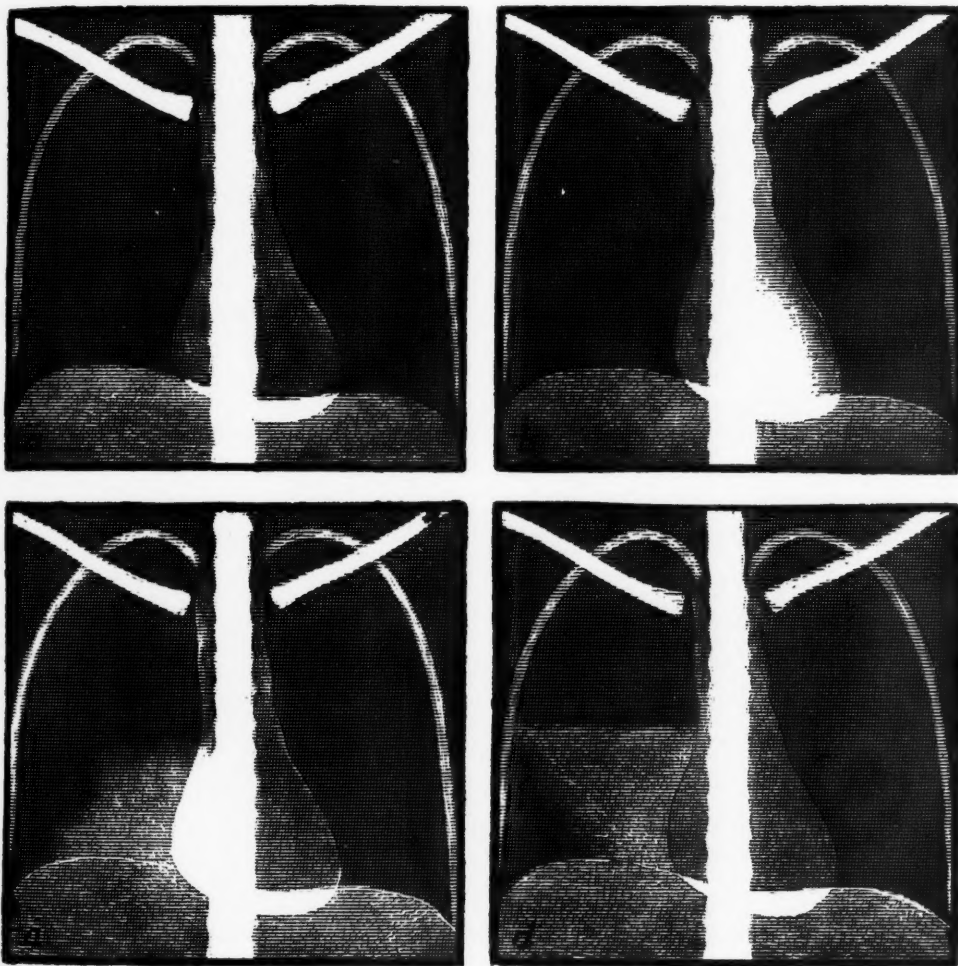


Fig. 2. Drawings of anteroposterior roentgenograms of the thorax. (a) Normal chest showing equal density of central shadow to the left and right of the spine and greater density in the center. (b) Lobar pneumonia, early stage, involving medial portion of left lower lobe only. Note the increased density of the heart to the left of the spine because of the superimposed shadow of the consolidation. (c) Lobar pneumonia, medial portion of right lower lobe. Note the density in the lung-field and the increased density of the central shadow to the right of the spine. (d) Lobar pneumonia, right middle lobe. Note the density of the lung-field without increased density of the central shadow.

in cardiac density applies more frequently to the left lower lobe, it is also occasionally of importance in the very early consolidations of the right lower lobe and the rather rare, localized pneumonia of the anomalous, inferior accessory lobe. Likewise, this sign may be used to aid in the differentiation of pneumonia of the middle from that of the lower lobe on the right side. Not infrequently when a consolidation of the right lung is observed in the anteroposterior roentgenogram, it may be difficult to make this distinction, if satisfactory lateral views are not available. An increase in the density of that portion of the central shadow to the right of the spine usually indicates an involvement of the lower lobe. The absence of such increased density does not, however, exclude pneumonia of the lower lobe, as only its lateral portion may be consolidated. This point is illustrated by the drawings shown in Figures 2c and 2d. The increase in the density of the cardiac shadow to the right of the spine is clearly visible in Figure 2c, and indicates the lower lobar origin of this pneumonia. This conclusion was con-

firmed by lateral examination. In Figure 2d is shown a consolidation of the middle lobe alone, which does not change the density of the central shadow. Obviously, some change may occur because of the small tongue of the middle lobe which extends anterior to the heart, but it is usually insufficient in thickness to produce any marked increase in density.

Other lesions than pneumonia may induce similar changes. Notable among these are the rather infrequent cases of bronchiectasis in which the disease process is almost completely confined to the medial portion of the left lower lobe. In some cases, the entire left lower lobe is involved and, by shrinkage, it assumes a medial position wholly behind the heart. Such cases may escape roentgen observation, although the clinical and physical findings are very obvious. Here again careful observation of the cardiac density may give the clue to the location of the lesion, following which, further examination may give a clear representation of the process. Films made in the anteroposterior projection with the patient supine, preferably with the aid of the

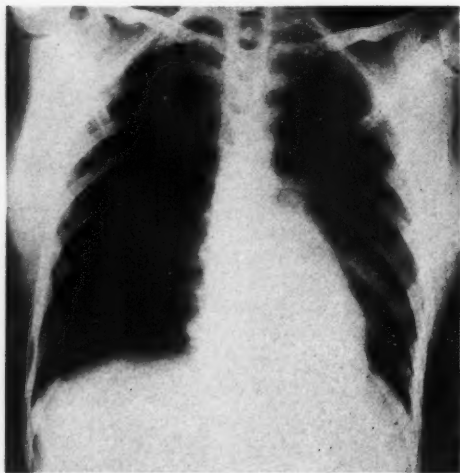


Fig. 3.

Fig. 3. Lobar pneumonia, medial portion left lower lobe, early stage. Anteroposterior roentgenogram, with patient supine. Note the increased density of the left side of the heart in contrast with the shadow to the right of the spine. The consolidation cannot be observed beyond the left border of the heart.



Fig. 4.

Fig. 4. Bronchopneumonia superimposed upon bronchiectasis, left lower lobe. Note the equal density of the central shadow to the right and left of the spine except for the inferior lateral portion of the heart where the consolidation increases the density to a marked extent.

Potter-Bucky diaphragm and considerable overexposure, will permit penetration through the cardiac shadow and reveal the findings perfectly.

Massive atelectasis of the left lower lobe from other causes may likewise give similar findings to those described above. In this instance, the elevation of the diaphragm and the displacement of the mediastinum indicate the nature of the process, but careful attention to the density of the cardiac shadow will serve to determine the location of the collapsed lobe.

Collections of fluid in the mediastinal portion of the pleural space, whether free or encapsulated, will also increase the cardiac density. If the usual postero-anterior roentgenograms alone are available, this change in density of the central shadow may be the only sign of fluid in the pleural cavity. This was pointed out as related to encapsulated mediastinal empyema in a previous publication (2), and has also been noted again by Snure (3). In certain cases of free pleural effusion, as described in another paper (1), the fluid tends to collect in the mediastinal portion of the pleural

space, giving a similar increase in the cardiac density. Such a case is illustrated in Figure 5, in which a free pleural effusion on the left side has extended into the mediastinal pleural space to increase the density of the left side of the heart. In Figure 6 is shown a similar case with fluid and atelectasis on the right side. The marked increase in density of the right portion of the central shadow is demonstrated by the contrast with the opposite side.

It should be apparent that any type of consolidating process in the medial portion of the lower lobes or any mass in the inferior mediastinum will produce, to a more or less degree, the findings described above. Tumor or abscess of the lung, tumor or other glandular enlargement in the mediastinum, aneurysm of the descending aorta, massive dilatation of the esophagus, and paravertebral abscess must be included in this category.

Abnormalities in the density of the cardiac shadow may also be due to intrinsic disease of the heart or pericardium itself. It is at once evident that pericardial effusion, while increasing the anteroposterior

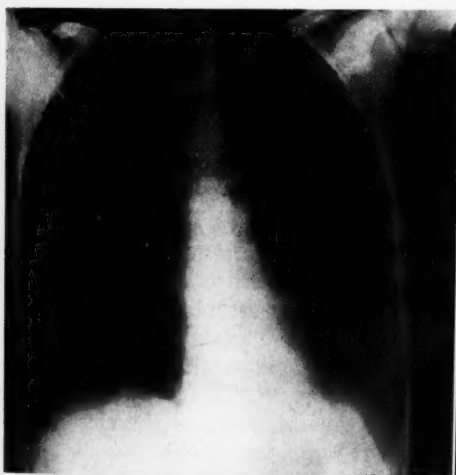


Fig. 5.

Fig. 5. Pleural effusion, left side, with extension behind the heart into mediastinal pleural space. Note the striking increase in density to the left of the spine due to the fluid behind the heart. Diffuse density over the lower left lung-field is due to a thin layer of fluid in the peripheral pleural cavity.



Fig. 6.

Fig. 6. Pleural effusion, right side, with extension into right mediastinal pleural space. The contrast between the increased density of the heart to the right of the spine compared to that on the left is marked. Note the other evidences of effusion, and the signs of atelectasis and pleural adhesions as well.

diameter of the heart, and thus its density, will ordinarily produce such a uniform change that there will be no relative discrepancy in the shadow of the two sides of the heart. In rare cases, encapsulated, purulent pericardial effusion may cause a variation in the density of the cardiac shadow, but this is usually evident from the change in the contour of the shadow. Enlargement of the left ventricle does not appear to disturb this relative density, probably because the heart is rotated sufficiently to compensate for the increased anteroposterior thickness on the left side. The same is true of enlargements of the right ventricle and right atrium. In the case of the left atrium, however, enlargement may produce changes in the density of the various portions of the heart. The left atrium being posterior and centrally placed, its shadow is normally lost within that of the spine and mediastinal structures. When greatly enlarged, however, it will project to some extent to both sides of the central shadow and thus increase the density of that portion of the heart which is abnormally overlapped. The so-called "double shadow," observed over the right side of the heart in cases of massive enlargement of the left atrium, is, in fact, caused by the increased density of the cardiac shadow in its superior portion where both left and right atria overlap, as compared to the lesser density of the right atrium alone, as its shadow comes down to the diaphragm.

SUMMARY

The observation of the degree of cardiac density, particularly the relative density of the right and left sides of the heart, in films of the thorax, is an important aid in the diagnosis of lesions of the lungs and pleura. Increase in the density of the left side of the heart may be the earliest x-ray sign of lobar pneumonia of the left lower lobe. Increase in density on the right side may be used to differentiate lower lobe consolidations from those of the middle lobe on the right side. Other abnormalities such as localized bronchiectasis, atelecta-

sis, lung abscess, tumor, mediastinal pleural effusion, mediastinal tumors, and other masses may also manifest themselves in this way.

The density of the central shadow should always be considered when examining roentgenograms of the thorax.

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DISCUSSION

WALTER H. UDE, M.D. (Minneapolis, Minn.): It is indeed a privilege to open the discussion of this very interesting presentation.

Dr. Rigler has called to your attention the characteristic appearance of pathologic processes in the retrocardiac portions of the thoracic cavity. He has especially emphasized the changes in the density of the cardiac shadow which may be produced by pneumonic consolidations in the posterior medial portions of the lungs.

In my publication, in 1931, entitled "Roentgenologic Studies in Early Lobar Pneumonia," I called attention to the demonstration of retrocardiac consolidations by showing that they represented increased densities in the anteroposterior view, and that their presence and character could be further established by the lateral view. That the postero-anterior view is more advantageous than the anteroposterior is apparent, since the portions of the lung to be studied are thereby brought nearer the film. Since this is the usual type of film to be made at the bedside of the pneumonia patient, the detection of such consolidations is thereby facilitated. The early lobar pneumonic triangular shadow may be demonstrated as well behind the narrow portion of the heart which projects

to the right of the spine, as behind the broader left lateral portion of the heart. For all practical purposes, the relative densities of these two portions of the cardiac shadow are the same, so that any increase in the density of one side as compared with the other should be noted and its significance determined.

If the triangular shadow of early lobar pneumonia is viewed along its long axis, it will become immediately apparent that the triangle is due to a cone-shaped consolidated segment of the lung, since in this view it presents a rounded or ovoid density. When this cone-shaped consolidation involves the upper medial portions of the lower lobes, the anteroposterior view presents a rounded homogeneous density overlying and projecting well beyond the hilum of the involved lung. This appearance formerly was interpreted as being due to "hilum" or "central" lobar pneumonia. The lateral film clearly shows that only the apical portion of these consolidated areas approaches the hilum, while the broad base which furnishes the rounded density is at the posterior periphery of the upper portion of the lower lobe. I, therefore, may repeat my previous recommendation that the term "hilum" or "central" pneumonia should be discarded.

Bronchopneumonic consolidations in the retrocardiac areas may likewise be identified by an analysis of the density of the cardiac shadow. Differential diagnosis from the more chronic basal inflammatory processes is, however, more difficult, since the bronchopneumonic shadows are not homogeneous in density, and are irregular in distribution.

R. R. NEWELL, M.D. (San Francisco): I am very enthusiastic about what Dr. Rigler has pointed out in regard to discovering lesions in the lungs which are hidden by the heavy shadow of the heart, and the same thing applies to the lower posterior corner where it is hidden by the heavy diaphragm.

We have made a practice for many years of studying fluoroscopically every patient

we could before we make films of the chest. You can usually, if you are suspicious of these conditions, pick them up in the lateral view.

One would say also that in bedside work it is usually possible to get a lateral view of some sort, even though the patient is very thick. I do agree that it is not so very important in which direction the x-ray goes through the chest. When you take an anterior view of the chest, you ordinarily set the tube down at a lower level so as to bring the apices above the shadows of the clavicles. If you project the line through to the front [illustrating on a fellow-member], then you see that in order to follow the same line in reverse direction, as when the film is placed behind the patient, then the tube must be way up above the patient's head. But if we use the same line of projection, it makes little difference whether it goes through the patient front to back or back to front.

There is another thing I would like to say: That the heart only interferes with the visualization of what there is in the lung behind it as a filter would interfere. That is, by increasing the necessary exposure, the heart does not really hide the shadow; it only makes the necessary exposure higher. But the heart also scatters x-rays, so that if you are trying to get views of what is behind the heart you ought to use a Bucky diaphragm.

One more word: I have long thought that an anterior and a lateral might often be better than a stereo-anterior if we are only going to use two films. It looks now as though in many instances we are going to have to use three films and a fluoroscopic examination, too.

The conclusion, of course, is that efficiency is not the same thing for a doctor as it is for an engineer. For a doctor, efficiency consists in working as hard as possible over every patient so that by wasting a lot of energy he may be sure he doesn't overlook something in one particular patient.

LEO G. RIGLER, M.D. (closing): I

think we are in thorough agreement except for the fact that, in taking films at the bedside, our experience has been at least that it is difficult to get the laterals—not that the technic is difficult but that their taking means rolling the patient on one side, getting his hands and arms up above his head; he has to hold his breath for a longer period of time unless you happen to be in the fortunate position of having a very powerful bedside unit. It is pretty difficult to get these in a very short period of time, so we have tried to avoid that purely, let us say, for the sake of co-operation with the clinician in acutely ill patients so as not to alarm them.

In our hospital I think the clinicians are much more dependent upon roentgen examination in pneumonia cases than they are on their own findings. We have finally convinced them that we disturb the patient infinitely less than they do, and we get much more information. We are in general agreement on that. At the same time, we

are anxious not to change the situation as far as disturbance of the patient is concerned.

I agree thoroughly with Dr. Newell that I would rather have a single postero-anterior or anteroposterior view and a lateral than a stereoscopic set, in the average patient who comes to you ambulant.

The focus-film distance at the bedside is distinctly less than what one would ordinarily use in routine examination. The result, particularly when you make anteroposterior films, is that the size of the heart is more exaggerated than it would be normally in most cases. The hearts look fairly large because of the short focus-film distance and the anteroposterior position. As a result, larger areas of the lung are overlapped and I am sure Dr. Newell is quite right in saying that the heart thereby increases the exposure necessary through that area. But we can take advantage of that increase in exposure by the difference in density of the two sides which results.

SOME EXPERIENCES, EXPERIMENTAL AND CLINICAL, WITH DIRECT IRRADIATION
OF NEUROLOGICAL TUMORS DURING OPERATION WITH
LOW VOLTAGE RADIATION¹

By JOHN RUSSELL CARTY, M.D., and BRONSON S. RAY, M.D., *New York City*

SURGERY for the treatment and cure of tumors of the brain and spinal cord has not reached a point where more than limited satisfaction can be obtained from a study of end-results. Relatively benign and encapsulated tumors such as meningiomas can be totally removed and some types of gliomas can be similarly attacked. More than 25 per cent of the gliomas are likely to recur even after an apparently total excision.

Because of many variable factors there has been little unanimity of opinion regarding the absolute value of x-ray therapy in the treatment of neurological tumors. At a meeting of the Association for Research in Neurology and Mental Deficiency, in 1935, the conclusions of those who took part in a discussion as to the value of x-ray therapy are as follows (we quote Elsberg):

1. Radiation has an undoubted effect upon many tumors of the brain.

2. The degree of effect is not known because there have been too few careful histological studies of the tumor tissue before and after treatment.

3. There is little exact knowledge of the relation of the amount of radiation used to the results obtained.

4. Profound changes in tumor cells may be produced by roentgen therapy.

5. In a large proportion of the patients the roentgen-ray dose was inadequate.

6. With methods hitherto used adequate doses of roentgen rays cannot be given because of the danger of injury to the soft and bony tissues of the head.

With these considerations undoubtedly in mind, Dr. Cushing in 1930-1931 planted

radium bombs consisting of radon seeds and sponge rubber dams in the excision cavities of the highly malignant glioblastoma multiforme. After a few days the flap was re-elevated and the bomb removed. After a short experience with this procedure he abandoned it. Others have used the same procedure without satisfactory results.

In 1937, Sachs, Moore, and Furlow, also Elsberg, Davidoff, and Dyke, published preliminary reports on the direct roentgen radiation of brain and cord tumors during operation, but little has been heard of this method since. Personal communication with some of those who have used direct irradiation has convinced us that the factor of safety is very small indeed when large doses are employed using radiation of 200 kv.p. This is further substantiated by the detailed reports of Elsberg, Dyke, *et al.* regarding the effect of large doses of 200 kv.p. radiation on the brain and spinal cord of monkeys, read before the International Congress of Radiology in 1937. The destructive effects of the radiation spread far beyond the confines of the primary beam.

From every theoretical consideration, except for the possibility of damage to closely grouped vital surrounding structures, direct irradiation is highly desirable. Bromley says, "Even when for various reasons the effect of the Chaoul beam has been to cause necrosis of tissue, the effect is very strictly localized and the recuperative powers of the immediate adjacent tissues are unaffected." Chaoul, Morison, Mayneord and others have given considerable attention to the physical factors involved. We will not dwell on this aspect except to re-emphasize that there is a rapid falling off in intensity in the superficial layers (1 cm.) and beyond. It is important to re-

¹ Read by Dr. Carty before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28-Dec. 2, 1938.

member that this limitation makes surgical removal of as much of the tumor as possible imperative, if results are to be obtained with low voltage irradiation.

We do not propose to enter into a discussion regarding the relative effects, if any, of high voltage *versus* low voltage irradiation on tumors, but merely to detail our preliminary experiences with the hope that they might be of help to others wishing to work along similar lines. They consist of a study of the effects of low voltage irradiation on the normal dog's brain and clinical experiences with 12 patients suffering from brain or cord tumors, with particular reference to any reaction which might be interpreted as the result of damage to normal structures.

A self-rectified, oil-immersed shock-proof unit was mounted upon a mobile platform. The outfit is capable of regulation from 30 to 100 kv.p., and, although heavy, can be readily moved to the operating room. There is a series of detachable cones of various lengths and sizes which are readily sterilized. The oil in the shock-proof head introduces a filtration element equivalent to about 0.5 mm. aluminum. The intensity of radiation is such that a dose of 2,000 r measured in air can be delivered at 20 cm. distance in 20 minutes.

Experimental Data.—Using dogs as experimental animals, we treated the brains of three groups with different dosages of low voltage radiation, namely, 6,000, 12,000, and 18,000 r units, all at 60 kv.p.

Intensity measurements were made in air with a small chamber Victoreen r meter. No filters were used, although there was an inherent oil filtration factor of approximately 0.5 mm. of aluminum.

The essentials of the technic were as follows: During nembital anesthesia a window about two centimeters in diameter was removed from the right parietal region of a dog's skull. The window was so placed as to overlie the motor cortex, but the dura was not opened because to do so would allow changes in the cortex to result from the irritation of drying, and manipulation. The dura is such a very thin structure in a

dog that it could hardly be a factor in diminishing the effect of radiation on the brain. A tubular cone having an aperture of 12 mm. and allowing a distance of 20 cm. from target to brain was used and directed so that the rays might pass through to the cortex of the opposite side of the brain.

Clinical observations were made during the administration of the radiation and at regular intervals subsequently. Dogs of each of the three groups, representing different dosages, were sacrificed after two weeks, seven weeks, and five months.

We are not yet prepared to make complete reports of the findings or to draw final conclusions, but a few interesting observations have been made. Some of these we shall list, as follows:

1. There were no significant changes in temperature, pulse, or respiration and no convulsions during the irradiation.
2. The wounds in *all* dogs healed satisfactorily.
3. The dogs given 6,000 and 12,000 r units never showed changes in their general health, nor did palsies, reflex changes, nor sensory changes develop.
4. The dogs given 18,000 r units showed immediately a lethargy, anorexia, and sometimes vomiting, which gradually improved until the dogs returned to normal after two weeks. These dogs all developed some degree of contralateral palsies (partial paralysis) of fore and hind legs within from seven to ten days. The degree of palsy usually diminished later. There were no gross sensory changes and no palsies developed on the same side of the body as the irradiation, *i.e.*, on the ipsilateral side.
5. When the dogs were sacrificed, brains of those having had 6,000 and 12,000 r units showed no *gross* changes, *i.e.*, the dura was not adherent to cortex; the cortical vessels, convolutions, and color appeared normal, and coronal sections through

the irradiated area appeared grossly normal.

6. When microscopic studies were made

gliosis. Very slight but unimpressive fibrosis of small vessels in the area was present. Else-

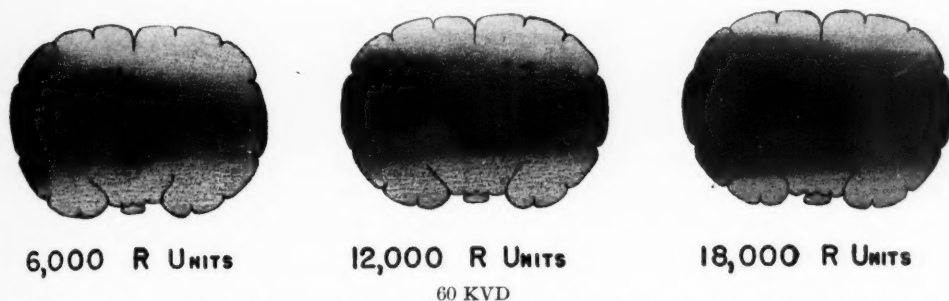


Fig. 1. Biological (isodose) diagram showing effect of low voltage irradiation on a dog's brain. The diagram represents the exact size of a coronal section of a dog's brain which has received 6,000, 12,000, and 18,000 r units, respectively, measured in air at 60 kv.p., without filtration, at 20 cm. distance. Histological sections were cut through the treated area and the number of degenerated ganglion cells were counted. The shading indicates the relative proportion of destroyed cells, the dark areas indicating the greater cellular destruction. Note the comparatively sharp lateral limitation of the beam and the shallowness of the maximum depth effect in the tissue. This represents an ideal condition in cases in which important normal structures are close by. It also indicates the necessity for removal of as much of the tumor as possible before treating.

of complete coronal sections of these brains having had 6,000 and 12,000 r units—

- (A) There were found at the end of *two weeks* cells in various stages of degeneration on the right side of the brain and along the course of the direction of the radiation. Away from the line of radiation degenerated cells occurred in diminishing numbers, and on the opposite side of the brain only a few scattered "sickly" looking cells were present.

- (B) It was found after *seven weeks* that many of these degenerated cells were being rapidly phagocytosed, there being fewer in evidence. A few degenerated ones were still in evidence; others may have recovered and returned to normal.

- (C) There was found after *five months* that in a comparatively superficial, localized, and well demarcated area of the cortex corresponding to the site of irradiation there was a paucity of ganglion cells and a moderate

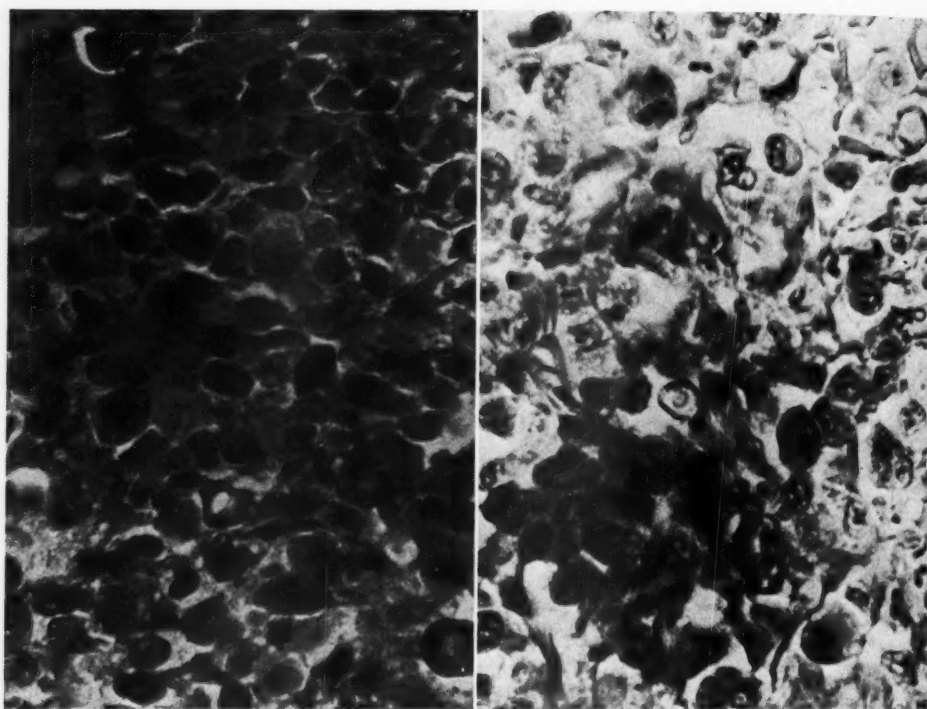
where in that lobe and in the opposite hemisphere, no changes of any kind could be noticed.

7. The difference between the effects of 6,000 and 12,000 r units appeared to be solely one of numbers of ganglion cells destroyed. The distribution of the damage was the *same*; the numbers of cells damaged for a given field in comparable areas was about twice as great in the brain that had had 12,000 r units.
8. Now when the dogs having had 18,000 units were sacrificed, the dura was locally adherent to the cortex and beneath it there was a small (1 cm.) area of discoloration and softening of the brain. The convolutions of a large part of the right hemisphere were flattened, a condition which was not true of the opposite hemisphere.
9. When microscopic studies were made of coronal sections of these brains (having had 18,000 r units), there was found—

- (A) At the end of two weeks, the right side of the brain showed extensive edema, hemorrhagic

infiltration, a well localized area about one centimeter in width and depth in which there was

(B) After seven weeks the localized area of degeneration just described had become frankly ne-



A

B

Fig. 2. Effect of low voltage irradiation 2,000 r, 60 kv.p., at 20 cm. distance, on a human epithelial tumor of the central nervous system. (A) Section of tumor taken following surgical excision of as much of it as was possible; (B) Section of tumor from the same region taken immediately on completion of direct irradiation, 20 minutes after the beginning of the treatment. Note cellular destruction and disorganization and irregular stain. This would indicate a direct effect on the tumor cells themselves rather than indirectly through action on the blood supply. More studies such as this should give us valuable information regarding the effect of radiation on tumors.

advanced degeneration with total absence of ganglion cells, and alteration in glial cells and in small blood vessels. Degeneration in cells elsewhere in the lobe was increasingly less evident at a distance from the direct line of the radiation. Throughout the opposite hemisphere there were scattered degenerated ganglion cells, although again they were most numerous in the direct line of the radiation.

crotic and there was beginning encapsulation of the region. Elsewhere the number of degenerated cells was less, many having been already phagocytized.

(C) The studies on these heavily irradiated brains after five months have not been completed.

10. No changes in the corpus callosum or basal ganglia have been detected.

One may be allowed a few conclusions from the work thus far. It appears that the dog's brain can stand dosages up to

12,000 r units at low voltage without showing clinical effects or more than minor microscopic changes. Using larger dosage (18,000 r), we have been able to demonstrate that with low voltage the *depth* intensity of the rays is limited, as indicated by cellular changes, and there is comparatively little scattering effect outside the limits of the direction of the beam.

Clinical Experience.—In the past year in the operating room we have treated through the open wound six tumors of the brain and six of or about the cord with low voltage radiation. In every instance the tumors were recognized as incurable: nevertheless, extensive excision was carried out before the radiation was administered. Usually a dosage of 2,000 r units at 60 kv.p. at a distance of 20 cm. was used. A cone suitable for the field was employed and wound edges and adjacent tissues protected with sterilized sheet lead.

In several cases sections were taken from the tumor before and immediately after treating. Very definite degenerative changes were noted in the sections made after—as soon as the radiation was discontinued. Both neurogenic and epithelial tumors showed this effect. To us, this seems interesting and significant. That radiation could, in the short period of 20 minutes, produce profound changes in tumor cells indicates that perhaps the factor of endarteritis is not as important in the effect.

Madeline P., aged 26 years, was operated upon just a year ago for a fairly large glioblastoma multiforme of the left frontal lobe. At a first operation we exposed the tumor and removed half of it; at a second operation, shortly after, a large part of the remainder was excised and the cavity was treated with 2,000 r units at 80 kv.p. at a distance of 20 cm. The time required to administer this dosage was 18 minutes.

Following an uncomplicated recovery she was started on the usual post-operative roentgen therapy. To-day she is an essentially normal individual with no evidence of recurrence.

We have no intention of pointing to this

case as unusual in its recovery period, for not a few cases of glioblastoma multiforme have gone a year or two before giving signs of recurrence, even when much less of the tumor was removed and perhaps no roentgen therapy was given. But she was the first case, and at least we found that the dosage used here was accompanied by no ill effects.

Margaret B., aged 51 years, was operated on for a large glioblastoma of the right posterior parietal region in September, 1937. We excised a fair portion of the tumor, leaving a large decompression. We had not then started to use the direct therapy method, but she was given the usual repeated post-operative series of roentgen therapy. After ten months her symptoms began to recur and she returned, nine weeks ago, with evidence of considerable intracranial pressure and a paralysis of the left arm and leg.

Three days after admission we resected all of the right temporal and occipital lobes and the posterior part of the parietal lobe within which resided the visible tumor. The basal ganglia were left intact. At the end of this procedure 6,000 r units of roentgen therapy, at 60 kv.p., and at an average distance of 24 cm., was directed at the amputated end of the right hemisphere. This therapy required one hour twelve minutes in addition to the three hours necessary to resect the hemisphere, but the patient, who had been under local anesthesia throughout, jokingly asked for a glass of schnapps as we were putting on the dressing.

Microscopic examination of sections from a small block of tumor that had been placed in the path of the radiation during the treatment showed chromotolysis, characterized by indistinct nuclei and increased density of the cytoplasm.

Her first post-operative week was satisfactory in every way—motion began to return to the left side, and there was little reaction. On the eighth day an unexplained fever developed and a paresis of the left side of the face appeared. Since no other cause could be discovered, it was as-

sumed that this was the result of a "delayed" reaction of the radiation. This seemed the more likely when we recalled that several of the cord tumor cases treated with direct radiation developed unexplained fever on the eighth to tenth days, though the fever disappeared within two weeks.

The facial palsy here gradually disappeared, but the fever and a tachycardia persist after eight weeks. Meanwhile, the patient has increased her activity and complains only of "weakness." The wound has healed and the intracranial fluid, which at first contained many cells and caused the decompression to bulge, now has diminished in amount and contains few cells.

We cannot say that the radiation therapy is responsible for the hyperthermia, but we suspect that it is and that the hypothalamus has been affected. Certainly the right motor cortex has not shown evidence of much, if any, damage.

Recapitulating our clinical experience, 11 patients with brain and cord tumors were given 2,000 r units at from 60 to 80 kv.p., and one with 6,000 r units at 60 kv.p. The longest period of observation was one year. Two of the cord tumor cases and one brain case developed unexplained fever, which was temporary except in the case of the patient receiving 6,000 r, where it still persists after two months. A temporary facial palsy developed in this case also. With these exceptions no reactions were noted which could be attributed to brain damage from the radiation. Definite tumor-cell destruction has been noted within 20 minutes after the beginning of irradiation.

CONCLUSIONS

Our experimental and clinical experience with nervous tissue confirms the findings of Bromley and others that the effect of low voltage irradiation is sharply limited to the confines of the primary beam, and that the effect is rather sharply confined to superficial layers. Surgical excision of as much of the tumor as possible is essential if results are to be expected.

We wish to express our deep appreciation to Dr. George Heuer, whose co-operation and interest made this work possible, and also to Dr. N. Chandler Foot for his invaluable help with the pathological sections.

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DISCUSSION

SHERWOOD MOORE, M.D. (St. Louis): We have had the privilege of listening to a very valuable and scientific paper. About twenty years ago, at the suggestion of Dr. Vilray P. Blair, I gave what at that time was an immense dose of x-radiation to an incompletely removed metastatic carcinoma of buccal origin involving the glands of the neck. This dose was given through the open wound with subsequent closure. We continued to follow this procedure occasionally until about eight years ago, at which time we applied it to more cases in the neck and extended the application of the maneuver to the axilla in certain cases of breast cancer. Some time later this method was employed in the treatment of cancer of the bladder in conjunction with cystostomy. In May, 1936, this method was used to treat a medulloblastoma through a craniotomy. The experience that we had had in other anatomical regions led us to believe that very large doses of x-

radiation could be applied intracranially. We began with a dose of 6,000 roentgens (measured in air).

In our first cases, chiefly because of shock-proof equipment, we used 200 kv., 1 mm. Cu filter, and a 50 cm. distance. The time necessary for this treatment in what may be said to be the middle of a surgical operation was prohibitive. In consequence, we acquired a shock-proof, low voltage apparatus which allowed the administration of the necessary dosage in the minimum of time. The distance was reduced to the minimum possible. This varies from 10 to 15 cm. and there is no filtration. The object is to have the maximum absorption of ray by the tumor and the minimum amount of absorption in normal structures distal to the tumor. Treatment of tumors through the open wound has been done on 88 cases. Seventeen of these were one type or another of brain tumor, all of them inoperable. As suitable cases have been encountered we have continued this type of treatment of brain tumors but have gone to a lower value than 6,000 roentgens.

At present, no conclusions as to the value of this method of treatment of brain tumors can be drawn. We have yet to observe serious consequences. One child with a partially operable medulloblastoma in the region of the third ventricle received 6,000 roentgens to the remainder of the

tumor. The patient did very well for a while, but there was a recurrence of symptoms. Dr. Leonard T. Furlow re-operated on the patient and was able to enucleate the remainder of this tumor. In his opinion the enucleation was possible because of the radiation effects. He recently said that as far as he could determine, the child was entirely well and that he planned to report this case at some time in the future.

I am a firm believer in direct, low voltage, unfiltered irradiation after surgical exposure in hopeless cases of tumor. I believe we can in this way accomplish great good for otherwise hopeless patients.

JOHN R. CARTY, M.D. (New York): I wish to thank Dr. Moore for his very valuable discussion of this paper.

If low voltage radiation is used, the necessity for radical surgery is greatly increased. It is essentially a combined surgical and radiological procedure. Owing to the relatively few cases that we have treated, we are now in no position to evaluate end-results. When one sees very definite tumor destruction in the short period of twenty minutes there is a challenge, which perhaps it may be possible to meet, that the remaining tumor cells left after operative removal may be destroyed by radiation without serious damage to the normal brain structures.

A FURTHER CONSIDERATION OF THE ROENTGEN-RAY MANIFESTATIONS IN AMEBIC INFECTIONS OF THE LARGE BOWEL¹

By JOSEPH C. BELL, M.D., Louisville, Kentucky

INFECTION in man by the pathogenic ameba, *Endameba histolytica*, is widespread, not only in the tropics but also in most other parts of the world. Many persons who harbor this organism show little if any evidence of its presence and these may be classified as supposedly healthy carriers or as ones having very mild symptoms of the infection. Others have definite clinical evidence of the infection and are usually classified as cases of acute or chronic amebic dysentery, depending upon the duration and severity of their symptoms.

All will agree that it is of utmost importance not only to the one infected but to the public in general, as well, for the diseased individuals to be recognized and for suitable therapy to be instituted. The ultimate diagnosis rests on the demonstration of the infecting organism in the bowel content or in material removed from ulcerated areas in the bowel wall during a sigmoidoscopic examination. A possible exception to this, in a few cases, is confirmation of a presumptive diagnosis by response to specific therapy even when the ameba cannot be demonstrated. Any means of diagnosis that will aid in the detection of this disease should be welcomed and made use of by the workers in this field.

Until recently, the roentgen-ray examination of the large bowel of individuals suspected of amebiasis has been given little consideration as a diagnostic aid. We are indebted to Vallarino for first showing that definite variations from normal, readily demonstrable by the roentgen ray, take place in a large percentage of individuals suffering from this disease. He did not observe changes that he considered to

be peculiar to this disease alone, and in themselves diagnostic, but did find some that occurred with sufficient frequency to demand a consideration of amebiasis in the differential diagnosis in cases in which they were found. These observations were published in 1925 (1). In 1928, before the Royal Society of Tropical Medicine and Hygiene in London (2), he presented another communication on this subject. In it he emphasized the close correlation between the clinical, postmortem, and roentgen-ray findings in the cases studied. His conclusions were: "The ultimate diagnosis should be made at the laboratory, and the roentgen findings at present should determine the extent and possibly the severity of the infection, and check up the improvement following treatment." In this same communication he stated as follows: "If, even after repeated examinations of the stools, no amebæ can be found present, but the roentgen-ray findings give evidence of the presence of the characteristic filling defects in the large bowel, it may be advisable to place the patient under anti-amebic treatment, and the clinical course of the disease be checked up by roentgenologic examinations." In a personal communication in March of this [1938] year he again emphasized the importance of the roentgen examination in checking the results of treatment as well as the accuracy of the diagnosis. He stated, as he had done previously, that the cecum is the part of the large bowel most often affected and that abnormalities of the cecum may be taken as a fairly good indication of the existence of amebic colitis.

Weber (4), in 1933, gave a classic description of the changes in the large bowel that may be seen in amebiasis in the central and northern sections of the United States, if I may judge by my own experiences.

During the past four years I have had

¹ Presented before the Section on Radiology on the American Medical Association, in San Francisco, June 13-17, 1938.

the opportunity to study carefully 13 cases in which *Endameba histolytica*, or the cysts of this organism, were demonstrated in the stool, together with two others in which the diagnosis was considered proven by the changes present in the colon and the responses to specific therapy. Seven of these cases were presented before the Southern Medical Association (5) and two others before the American Roentgen Ray Society (6). Three of the most recent cases are included in this communication, together with a discussion of some of the observations made in this study. The number of cases is not large for the disease cannot be said to be common in this locality and these cases have been gleaned entirely from a private hospital and office practice.

Abnormalities Observed in the Examination of the Colon.—In 1933, Weber (4) wrote as follows: "The cecum demands particular attention. It has been the site of maximal roentgenologic change in every instance in which I have offered a diagnosis of amebic ulcerative colitis. Suppression of haustral markings, shortening, and narrowing, sometimes to the extent of almost complete obliteration of the lumen, have been observed uniformly in the cecal segment." He next called attention to the peculiar unimpeded rush of the opaque material from the large bowel into the ileum without delay at the ileocecal valve and without distention of the cecum, and again (3) strongly emphasized this finding in his discussion of my paper presented before the American Roentgen Ray Society.

My observations have been entirely in accord with those of Weber. The cecum has been definitely abnormal in each case in which a diagnosis of subacute or chronic amebic dysentery has been made. The changes have varied from loss of the normal markings, together with slight narrowing of the lumen and some loss of flexibility, to almost complete obliteration of the lumen. In some instances the margins of the cecum have been regular while in others they have been distinctly irregular. The changes have always been quite symmetrical in their distribution. In two instances

the abnormalities have been limited to the cecum but in the others there have been changes in other parts of the large bowel as well.

The peculiar rush of the material from the large bowel into the ileum has been seen in every case studied and has frequently been one of the most striking abnormalities observed. Weber says it is not difficult to distinguish between normal and pathologic escape of material from the large bowel into the ileum. I am in accord with this statement. It is unfortunate that the term "incompetence of the ileocecal valve" should have been used in the discussion of this condition for the term has been used mistakenly to designate as pathologic what is actually the normal escape of material from the large bowel into the small when the cecum is overdistended. It is now generally recognized that the opaque material will normally flow from the large bowel into the small following overdistention of the cecum, especially if the ileocecal area is manipulated. The behavior in the cases with amebic infections, however, has been entirely different from that just mentioned and by the experienced examiner should readily be recognized as pathologic. The passage of material from the large bowel into the small in treated cases may continue to be somewhat more free than normal even after the bowel becomes normal otherwise. In such cases it would seem that the abnormality is the result of past disease rather than an indication of continued activity of the infection.

The deformity of the cecum has been constant in form except after treatment has been instituted, when contraction waves appeared and usually continued to be present until the cecum returned to normal. This characteristic is in marked contrast to the ulcerative form of tuberculosis in which active spasm is a characteristic finding. Hyperplastic tuberculosis of the cecum may simulate exactly the cecal changes sometimes seen in amebiasis and may be primary in the ileocecal area. However, according to Brown and Samp-

son (7), this form of intestinal tuberculosis is rare and the primary type exceedingly rare. I have seen one case considered to be hyperplastic tuberculosis that exhibited all the above changes including the ex-



Fig. 1. Case 1. Cecal pouch almost completely obliterated. Terminal ileum distended. Area of narrowing in transverse colon considered to be due to invasion of the bowel wall by the *Endameba*

tremely rapid escape of the opaque material from the large bowel into the small. In this individual there was an active tuberculous lesion in the chest and a lesion causing a partial obstruction in the ileum. The diagnosis seemed apparent and tuberculous lesions of the ileum and cecum were demonstrated at operation.

It has been said by others that the lesions of the cecum may be indistinguishable from early carcinoma. This certainly is not true in cases in which the infection involves not only the cecum but other parts of the large bowel as well, which is true in the large majority of cases. In my cases, even when the cecum alone was involved, the changes were such that I felt justified in saying that the lesions were not carcinomatous.

I have had little experience with the acute bacillary dysenteries but in the few seen the type of ulceration has been different from the subacute and chronic amebic cases. The ulcerated portion of the bowel has been continuous, changes have been most marked in the distal part of the bowel, and the cecum has not been involved. It is probable that the infection may extend into the cecum in some instances and cause changes similar to an amebic infection. In such cases, however, amebiasis can be ruled out, for the trophozoites or cysts should readily be demonstrable by an adequate stool examination in any case with an active dysentery in which there are changes in the bowel wall that are at all extensive if due to amebiasis. Chronic ulcerative colitis may simulate an amebic infection closely and may extend into the cecum, but again the two should readily be differentiated by adequate stool and sigmoidoscopic examinations.

Changes in the Bowel Distal to the Cecum.—In the cases studied and classified as subacute or chronic amebic dysentery, the ulcerated areas in the bowel distal to the cecum have seldom been continuous but have been separated by apparently healthy portions in contrast to the usual continuous involvement seen in chronic ulcerative colitis and acute infectious colitis. One exception to this was a case that apparently was proven to be both chronic amebic dysentery and chronic ulcerative colitis. In acute amebic dysentery the involvement may simulate closely the changes seen in other forms of acute dysentery.

The so-called amebic granuloma may exactly simulate a carcinoma but in my cases each lesion has been accompanied by definite changes in the cecum that were considered indicative of an amebic infection. Again, an adequate stool examination should determine the diagnosis in the large majority of such cases or a therapeutic test may be resorted to if necessary.

The Stool Examination.—An amebic infection of the large bowel should not be con-

sidered ruled out unless on three consecutive days, after saline catharsis, trophozoites or cysts fail to be demonstrated in the bowel content by a competent paracytologist. I have been impressed by the frequency with which one receives the answer that a stool examination has been done and is negative when the possibility of an amebic infection is suggested and how frequently the findings are positive when an adequate examination is done. It should be recognized that many laboratories are not competent to make this diagnosis although they may be quite reliable otherwise.

The Sphere of the Roentgen Examination.—The roentgenologic examination is not a primary diagnostic method. It will seldom yield information of value in the examination of the healthy carrier or the individual with very mild clinical symptoms. In acute amebic dysentery the diagnosis can usually be made by the stool examination and this is the obvious method to employ. In these cases the bowel is generally so irritable that the roentgenologic examination is very unsatisfactory and the changes present may not differ from those seen in other forms of acute dysentery.

In chronic amebic dysentery the stool and sigmoidoscopic examinations are again the primary diagnostic measures, but here the symptoms may be such that the possibility of amebiasis may have been overlooked or the specific organism not have been found in the stool. A presumptive diagnosis of amebiasis may lead to a more careful examination and result in a positive diagnosis or may make possible the confirmation of a presumptive diagnosis by a therapeutic test followed by re-examination of the colon. In at least one-third of my cases the possibility of an amebic infection was first considered only after a presumptive diagnosis of amebiasis had been made following the roentgenologic examination of the colon. A contributing factor in this may have been the fact that in some instances other pathology was also present, two patients having duodenal ulcers and one, gall-bladder disease.

The roentgenologic examination is of primary importance in demonstrating the extent and severity of the disease and in determining the response to treatment. The stool may become free from parasites



Fig. 2. Case 2. Dependent half of cecal pouch narrowed and slightly irregular in contour. Slight narrowing of first part of ascending colon. Terminal ileum distended. Changes suggestive of amebic infection but not characteristic.

long before the bowel returns to normal and until the bowel is normal it would seem unwise to consider the patient free from the disease.

The Experiences of Some Others with the Roentgen Examination in this Disease.—Manson-Bahr (8), head of the clinical division of the London School of Hygiene and Tropical Medicine, says that his experiences with the roentgenologic investigation in this disease have been very disappointing. Dr. Mather Cordiner, the head of the x-ray department of the Hospital of Tropical Diseases, in a letter to Manson-Bahr writes as follows concerning the changes in the cecal area observed in his cases: "From my own experience, I do not regard the deformity described [re-

ferring to the cecal deformity described by me before the Southern Medical Association] as being diagnostic of amebic dysentery. My own feeling at the present moment is that we can only indicate the

ing in conjunction with Ruffin of the same institution, says that in a series of 54 cases with amebæ in the stools, 19 were examined by x-ray and abnormalities considered to be due to amebiasis were found



Fig. 3. Case 2. Serial films of cecum made during treatment showing type of contraction of cecum frequently observed shortly after anti-amebic therapy has been instituted.

presence of a colitis radiographically, but I am unable to find any radiographic manifestations to indicate the specific nature of the lesion."

A. A. deLorimier (9), of the Gorgas Hospital, Panama Canal Zone, says that it has been his experience that the cecum is the part of the large bowel most often affected. He looks for flattening of the haustral markings, residual flecking, and for extension into the distal part of the bowel. He attaches no significance to escape of material from the large bowel into the small unless it rushes past the valve with no apparent delay whatever.

Reeves (10), of Duke University, work-

ing in the colon of 68 per cent of these. What he considered to be cecal involvement was present in 38 per cent of this group. In one instance there was a lesion that closely simulated a carcinoma but there was also cecal invasion. Ruffin (11) says that in no case in this group could the diagnosis of amebic dysentery be definitely established from the x-ray findings alone.

J. Cash King (12), of Memphis, Tennessee, found in a series of 12 cases with *Endameba histolytica* in the stools that there were abnormalities in the large bowel considered to be due to the amebic infection in each. The cecum was found to be abnormal in eight and in three the pos-

sibility of an amebic infection was first suspected when suggested by the x-ray findings.

As will be seen from the above communications, there is a marked difference in the opinions of workers as to the value of the roentgenologic examination in this disease as well as to what each considers the significant variations from normal.

Case Reports.—Case 1. I. B., a white adult male, entered Norton Memorial Infirmary on Nov. 11, 1937, with a history of abdominal discomfort, loss of weight, malaise and diarrhea for a period of one year previous to admission. The stool contained pus, mucus, and at times blood.

A gastro-intestinal examination was done. The upper gastro-intestinal tract was normal. The barium enema showed localized areas of irritability in the transverse portion of the colon. The mucosal folds were not well defined. The cecal pouch was almost entirely absent and the opaque material rushed from the large bowel into the small with no delay in the ileocecal area. The possibility of an amebic infection was suggested and a stool examination revealed numerous very actively motile amebæ to be present.

Re-examination one week after treatment was instituted showed the cecum to be larger and considerable irritability to be present. The appendix filled and irregularities suggestive of ulceration were seen. The bowel movements became normal one month after treatment was instituted, the patient gained weight rapidly, and is now well from a clinical standpoint. He has not returned for a follow-up examination as requested.

Case 2. M. M. M., a white adult male, 45 years of age, entered the Norton Memorial Infirmary on Feb. 20, 1938, with a history of right upper quadrant pain, temperature, and diaphoresis of ten days' duration. He gave a past history of a persistent diarrhea at the age of ten years. He went to New Mexico where his health improved and the diarrhea ceased. He was well until 14 years ago when, at the age of 31, he had a severe illness char-

acterized by high temperature, right upper quadrant pain, and tenderness in the right upper abdomen. A laparotomy was done and two liver abscesses found and drained. The material removed proved to be sterile upon culture. The post-operative convalescence was uneventful. Elevations of temperature for a brief period took place at intervals of about two years after this illness. These were controlled by intravenous injections of mercurochrome or gentian violet. Twelve years ago emetine was used in medication for a short time, although amebæ had never been found in the stool.

The patient had been free from symptoms for a period of three years prior to Oct. 1, 1937, when he again developed a high temperature, right upper quadrant pain, and diaphoresis. The bowel movements were normal at this time and had been normal at all times after his visit to New Mexico in childhood.

A proctoscopic examination was done which was said to have been normal. A blood examination showed the hemoglobin to be 62 per cent. The red blood cells numbered 3,240,000 and the white blood cells 10,500. A roentgenologic examination of the chest and gastro-intestinal tract showed the right side of the diaphragm to be slightly elevated and the respiratory excursion to be markedly limited. The cecum showed definite decrease in the size of the lumen and there was a rush of the opaque material from the large bowel into the small as the cecum filled. In interpreting the findings, the possibility of an amebiasis both of the liver and colon was suggested. A stool examination the following day, after saline catharsis, revealed many actively motile amebæ considered to be *Endameba histolytica*. Thorough anti-amebic treatment is in progress. The temperature subsided promptly and marked clinical improvement has taken place. Re-examination on May 3, 1938, showed the position and excursion of the diaphragm to be normal. The tone of the cecum was still increased and the margins were not well defined. Improvement was

evident but the bowel still showed what was considered to be evidence of disease.

Case 3. This patient, white adult male, went to his neighborhood physician with a history of having been constipated for

I re-examined this patient one week later. There were irregularities in the wall of the sigmoid and descending colon characteristic of ulceration. The lumen of this portion of the bowel was definitely narrowed. The



Fig. 4. Case 3. Cecal pouch obliterated. Terminal ileum greatly distended. Localized area of narrowing in transverse colon considered to be due to invasion of bowel wall.



Fig. 5. Case 3. Narrowing of lumen of proximal half of rectum and distal third of sigmoid with irregularities in margins of bowel wall considered due to ulceration.

years, until October, 1933, when he began to experience soreness in the lower abdomen after which he developed a diarrhea. This was followed by a perirectal abscess that ruptured spontaneously. The diarrhea continued from that time until the time that he visited his present physician although various forms of therapy were prescribed by other physicians. His present physician made x-ray films of his colon after a barium enema and sent them to my associate, William Curry Martin, M.D., for an opinion as to the nature of the changes present. It was Dr. Martin's opinion that they were those of an amebic infection of the large bowel. A stool examination was recommended and at the second examination after saline catharsis many actively motile amebæ were found.

lumen of the cecum was almost completely obliterated and there was a rush of the opaque material from the large bowel into the ileum.

Under treatment the patient has improved greatly: the diarrhea has been controlled, the bowel movements are normal, and the weight has increased markedly. From the clinical standpoint the patient is well at present. He has not returned for re-examination as requested, as yet.

COMMENT

My purpose in presenting this communication, and the earlier ones, has been to call attention to the changes that may be found in this disease. These changes have all been described by others prior to me

and my observations are simply a confirmation of their findings. I do not believe that the x-ray examination should be considered a primary factor in the diagnosis of this disease nor that an x-ray diagnosis of amebiasis should be made unsupported by clinical and other laboratory findings. In my very limited experience, however, no case has been seen presenting changes thought to be characteristic of this disease, in which subsequent investigation or a therapeutic test has failed to confirm the accuracy of the presumptive diagnosis.

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THE TREATMENT OF HYPERTHYROIDISM, WITH A CONSIDERATION OF OTHER OF THE DUCTLESS GLANDS AS A TRIGGER MECHANISM

BASED UPON THE OBSERVATION OF 360 CASES¹

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FOR a radiologist to discuss the treatment of hyperthyroidism by any method except radiation therapy to the thyroid only, might result in an indictment of heresy, because it seems that we are being jammed into this thing called specialism by the public, and by the medical profession as well.

About two decades ago my interest in medicine, generally, was suddenly diverted to the field of radiology, and in due course of time I became affiliated with that specialty. It was, therefore, natural that I was soon referred to as "an x-ray doctor." True to orthodoxy, I tried to act the part of a specialist, and see things medical from the viewpoint of a radiologist. For instance, in the therapeutic field of x-ray I would treat a case of thyrotoxicosis, directing my entire attention to the thyroid gland, and wait for a responsive cure. If my efforts did not result in a cure, I was sorely disappointed, and wondered why the case did not respond favorably. Likewise, I also found the surgeon upset by many recurrent goiters after sub-total surgical removal, and he, too, wondered why his efforts were futile.

Close analysis of my patients and a study of endocrinology finally delivered me from the specialist complex, and gave me a new birth into the realm of medicine. Now, after two decades of trying to practice a specialty, I am forced to admit that such a thing as a specialty in medicine, according to the accepted definition, cannot exist.

The human body is one composite unit, and one organ cannot be vitally or dangerously affected without affecting other parts.

If we keep informed of the laboratory findings of the physiologist and the endocrinologist, we must be convinced that the ductless glands are so inter-related that to affect one and not another is impossible. I shall make no attempt at laboratory-proven inter-relationship of the endocrine system, for the beaches of this uncharted sea are strewn with wrecked fantastic hypotheses. I shall back my assertions by the teachings and investigations of those who lead in this little-known field of pathology and by the presentation of cases suffering from this thyroid syndrome. These patients are well now, cured by attention directed in part, or wholly, to another part of the ductless gland system than the thyroid itself. I shall try to show that pathological changes in one gland may affect another gland, may stimulate or perhaps depress. I shall present cases of so-called thyrotoxicosis that, without doubt, were activated by other parts of the endocrine system and were relieved by attention to other of the ductless glands, giving little attention to the thyroid.

In contradiction to my former effort to cure thyrotoxicosis by the application of x-ray to the thyroid alone, I am proposing that we accept and put into practice present-day laboratory teachings, and discard the ideas and practices of men long since dead. We should base our treatment upon correct interpretation of an impaired correlation of endocrine forces. I am not proposing to prove that some other gland is having a synergistic or inhibitory influence upon the thyroid, but to show there are almost always symptoms pointing to other endocrine dysfunctions which may give us the proper lead. Many times we are unable to put our finger upon all the disturbing factors, but a careful history as

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to previous health and present behavior, environment, and hereditary factors, and also closely analyzing the patient as to temperament, etc., may lead us into the right analysis. We may be forced, and often are, to choose the method of "trial and error" to control a thyrotoxicosis. Occasionally we are not able to place the blame upon any but the thyroid itself, and are then forced to direct our efforts entirely to that gland. In such a case there is only one thing to do, namely, to break the endocrine cycle. This may be accomplished by attacking the thyroid, and this, in a certain number of cases, may produce a cure. Many of these same cases would perhaps be benefited as rapidly and just as satisfactorily if we should attack the chain at some point other than the thyroid, but to handle any case in this manner is by no means scientific for we may treat the effect and not the cause. Infrequently we see a case with a gland large enough to be producing sufficient mechanical pressure to demand instant relief, and surgery in such cases is advisedly employed. The colloid non-toxic thyroid does not come under the head of this discussion and is, therefore, not considered. I am frequently confronted with complex cases, impossible for me to diagnose at once, but there is "saving grace" for me in the fact that even the endocrinologist does not always quickly make a satisfactory diagnosis in endocrine upsets. So if I recognize the fact that a thyrotoxicosis may be secondary to an endocrine imbalance rather than being a thyroid entity, I will come through with the approval of the endocrinologist and physiologist, and it is my opinion that, in this complex field of human illness, these scientists stand supreme.

In the past, as soon as symptoms referring to a hyperthyroid and an increase in metabolism were encountered, I, as radiologist, or you, as surgeon, condemned only the thyroid and applied to it our agencies of cure.

It is surprising to see young men walk from the tutelage of the physiologist and

forget or disregard the vegetative nervous system, which so often holds the key to the door that guards the secrets of endocrine activity.

All these lamentations are merely the expressions of a "penitent sinner" who is exhorting himself and his brethren to view the endocrine system, each gland vitally related to the others. When one is thrown out of synchronism, then another may be stimulated or depressed. Our ability to evaluate and locate the etiology of thyrotoxicosis will be in direct ratio to our knowledge of the ductless gland system. If we are not able to diagnose correctly, our therapeutic ability will continue to be guess-work of "the hit and miss" variety.

The female species of the human race seems more susceptible to goiter than the male, with a ratio of five to one. Perhaps this is because there is a constant evolutionary change in the ductless glands of the body, from the age of adolescence until the climacteric has established a new endocrine balance. If she does not develop all the endocrine system perfectly, glandular synchronism cannot obtain, and if synchronism does not harmoniously evolve in the ductless glandular system, we may see the development of a hyper- or hypo-active thyroid gland, a depressed adrenal, a hypofunctioning of the pancreas, or a hyper-active pituitary.

The internal secretion of the thyroid may be entirely under the control of the anterior pituitary, through its thyrotropic hormone, and perhaps affected by the behavior of the adrenals and sympathetic nervous system also. Toxins of disease act upon nervous systems as a whole, which may stimulate or depress the adrenal and/or thyroid activity.

Pottenger states:

"Unfortunately we cannot differentiate the effects of toxemia as it expresses itself in the endocrine glands from that expressed through the nervous system. There are important endocrine glands, however, which are stimulated by it, particularly the adrenals and thyroid. These derive their activating nerve supply from the sympathetics, hence are stimulated to increased activity by toxins. The result is in-

creased metabolic activity. One can readily understand, then, that toxemia exerts a multiple influence which favors loss of weight, a depressed function of the gastro-intestinal organs which fail to provide sufficient pabulum, an increased metabolic activity which hastens the breaking down of the body tissues, and an injury to cells which interferes with assimilation."

In a given case in which some toxemia is productive of an increase in metabolism and the thyroid syndrome, neither x-ray nor surgery would be palliative or beneficial, but, on the other hand, might be destructive. In a given complex case in which the metabolic forces have been upset by some imbalance of the endocrine system, relief may be brought to the thyroid sufferer by breaking the cycle at any place in the system. In such a case, thyroidectomy or suppression to the pituitary or ovarian activity by x-rays may be equally effective, and in such a case the method employed may be, and should be, controlled by the following factors: (1) method least hazardous to life; (2) shortest time out for treatment; (3) expense of method employed.

In deciding why a given case is a victim of thyroid syndrome, we are burdened with the responsibility of showing our ability as internists and, in doing so, we look first for focal infections, pathological entities, and abnormal functioning of another factor of the endocrine system. We must also employ the aid of what the physiologist and endocrinologist have to offer. What we wish to do is to devise a treatment to be applied to the cause and not the effect. In other words, the so-called goiter may be the effect and not the cause of the patient's illness.

The following cases have helped to mature my present opinion concerning the treatment of hyperthyroid syndrome. My awakening began when a young woman school teacher was finally diagnosed as a victim of hyperthyroidism by her brother who was a doctor, and who called me to treat her. She was 26 years of age, married, and had no children, and was suffering from a symptom-complex that had been ushered in by a menstrual period. Her

sickness was first diagnosed appendicitis and then ectopic pregnancy. When the period had passed and all the pain had disappeared, she was still nervous and had a fast heart, *et cetera*. At the time she was diagnosed as hyperthyroid. X-ray treatment to the thyroid produced a slow gain and it was noted that during each succeeding menstrual period for the following four months, all symptoms were increased and almost all of the ground gained in the interim was lost. My conclusions were that her menstrual cycle was the trigger mechanism which set off her thyroid activity, and I determined upon x-ray sterilization. I secured her consent, and treatment by x-ray to the ovaries produced a menstrual cessation. Her basal metabolic rate automatically came to normal within three months' time. She has been well since 1926. This spectacular recovery determined me to sterilize other goiter patients, if their menstrual cycle offered a clue as the trigger mechanism, when their consent could be secured.

Observation of the peculiar behavior of some of my patients prompted me to classify many of them suffering from hyperthyroidism as the victims of a "symptom-complex." Consultation with endocrinologists, and a study of their literature on the inter-relationship of the endocrine system, convinced me that the thyroid, when over-active, might be synergized by another of the ductless glands, or else the over- or under-activity of other endocrines might throw the thyroid out of normal activity.

As above indicated, my first impressions of diseased thyroid meant that it alone needed attention. My observations in private practice have convinced me that the relationship of the endocrine system is so varied and complex, that I am forced often to tell my patient that it may take me a few weeks to decide fully as to the trigger mechanism in her particular case. There are cases of hyperthyroidism synergized by, or hindered by, the pituitary, adrenals, or ovaries, whose vicious cycle may not be *permanently* broken when at-

tention is given only to the thyroid. I have just emphasized *permanently*, for with the treatment directed wholly to the thyroid gland, there may be a complete failure of any method used, and a recurrence of symptoms, and in cases in which a sub-total removal is practised, even a recurrence of the gland itself.

I have previously reported a mother, 26 years of age, with two children, who had a sub-total thyroidectomy performed twice, once in 1936 and again in 1937, and in 1938 had a third return of the gland, larger than ever before. Her mother died of goiter when the patient was six years old. She has two sisters and one brother who are suffering now from goiter. Examination showed a nervous woman, anemic and almost hysterical from fear of death from goiter. Her weight was 93 pounds, menstruating normally every 28 days, libido considerably increased. Pulse rate 120, basal metabolic rate +26, exophthalmos +2. Thyroid enlargement was 10×10 cm., and protruded 2.5 cm. (in other words, the gland was as large as half a medium sized orange). The subject looked such a poor risk that I almost refused her case, and I informed her husband that I might be several weeks in deciding what other gland or glands beside the thyroid were in the "hook-up," to make her so ill and her response to treatment so obstinate. I made the following statement to him and often make it to others: "To know the cause of hyperthyroidism is often to have accomplished half the cure."

One with a +26 basal metabolic rate would not be expected to be as ill as this patient appeared to be. Her heart rate was too high for an ordinary thyrotoxicosis, and, to my mind, this implicated other glands, probably the adrenals and pituitary. I applied x-rays to her thyroid at weekly intervals and began a close analysis of her at each visit. Her nodular, or Plummer, thyroid gland did not soften; her basal rate stood still; her heart action remained fast; there was no gain in weight, or desire for food. Even though the patient was growing slightly weaker and more

nervous, her libido sexualis remained 100 per cent above normal level. This observation made me believe the hypophysis was her trigger mechanism, and influenced my decision to discontinue thyroid radiation and turn to raying the pituitary and the ovaries. The tide immediately turned and at the end of four months she had gained 23 pounds, her heart rate was 72, the gland one-third reduced, her exophthalmos reducing, and all tremor gone. She looked well and was taking care of household duties and her place in society.

It was formerly my opinion that all victims of hyperthyroidism were thin or losing weight. This is not always true. I present a case of a young girl, 16 years of age, who was very fat and nervous and with moderate hyperplasia of the thyroid. There was a beginning divergent strabismus. She was on a restricted diet to control her weight. Examination revealed an easily excited girl, who cried often, who could not lie still, and was sleeping poorly. Her heart rate was 140, her basal metabolic rate was +45, her height five feet six inches, and her weight 155 pounds. Menses were normal. Treatment to the thyroid and hypophysis was instituted. Quinine hydrobromide was given to slow her pulse, and bromides to produce sleep. Improvement was noticeable at the end of four weeks. Her nerves were quiet, crying had ceased, her pulse rate had decreased, and the basal rate had made a gradual decline. The strabismus had improved until she could resume her studies, and at the end of four months she was dismissed as symptom-free.

These and many other experiences lead me to believe that most thyroid symptoms are secondary to other glands of the endocrine system, and that the pituitary is first, the ovary second, and the suprarenal third, as primary to hyperthyroidism. The following case of increased metabolic rate was unquestionably secondary to suprarenal insufficiency: School teacher, age 24, had pneumonia, empyema and rib resection, followed by slow convalescence, with menses lasting almost continuously

for several weeks. Curettement and medication afforded no relief. She was anemic, weak, and had a yellow-bronze skin with seborrheic acne. It was the acne that brought her to my hands. Among other things, examination revealed that she had a basal metabolic rate of $+116$. She was leaving for the West Coast, and could not have x-ray at that time. I prescribed for her anemia some one of the liver and iron tonics. Her color and general apathetic condition made me suspect her adrenals were hypo-active, and cortin was given for this condition. She followed the treatment for six weeks while on the Pacific Coast, and when she came to see me again she was a well woman, with a basal metabolic rate of $+10$. I am convinced that her adrenals were hypofunctioning, caused from the influenza and pulmonary involvement, and in some way her thyroid was stimulated into this severe activity. Sugar tolerance and blood cholesterol tests were not done, as time did not permit. Three years have passed and she remains well. She has had no x-ray and no surgery. If she had remained in my city at the time I first saw her, I would have given her roentgen treatment and would have credited x-ray with having made a wonderful cure.

For one to place confidence in a stereotyped remedy, whether medicine, x-ray, or surgery, is to me the height of absurdity. I attribute the most satisfactory results of the last few years of my thyroid experience to having taken each case of thyroid disturbance on its own merits, and worked out the diagnosis of the causative factor of the dyscrasia, by scientific tests, insofar as is practical and known, or by "trial and error." If I am slow to find the exact combination of endocrine upset, I empirically reduce the activity of the thyroid, to the point of a normal metabolic rate, by x-ray. I admit this to be a poor practice, but some of the thyroid syndrome cases are so complex, there is nothing else left to do. I am consoled by a personal communication from William Wolfe, who states that, "In many of these so-called thyroid cases, it is difficult to tell whether the thyroid

was affected first and the other glands later or whether the reverse was the course of events. In either case, it is a vicious circle and it is perhaps of minor importance at which point it is broken."

In a personal communication from another one of America's recognized endocrinologists, in the discussion of the treatment of hyperthyroidism, he states: "It is my opinion that advocating total thyroidectomy in all cases of hyperthyroidism, is pernicious and unwarranted."

Still another internationally known endocrinologist writes me:

"Hyperthyroidism, so called, is but seldom a primary disease of the thyroid gland. I have reason to believe that the cause of the trouble is an extra-thyroid metabolic disorder in the course of which the thyroid is over-stimulated, and participates in the disease as a secondary manifestation. The beneficial results of surgery are comparable to those of amputation of an extremity for peripheral vascular disease. The amputation does not check the disease, nor the gangrene, which develops as its manifestation, but merely the organ on which the disease made its most conspicuous appearance."

There are surgeons who now advocate a total thyroidectomy who once held up their hands in holy horror, in fear of the radiologist producing a case of myxedema. These same men now propose to do a total thyroidectomy, thereby producing a positive myxedema in every case. An unvarying plan of treatment for any disease now, especially a toxic goiter, should be proclaimed from the housetops, as outlawed medicine for the treatment of hyperthyroidism should not in any manner be a stereotyped affair. In addition to roentgen ray, I often find myself employing biologicals, to boost a gland that is dysfunctioning, whose inactivity in some way may have been the synergistic factor in producing a hyperactive thyroid.

SUMMARY

Thyrotoxicosis is considered a symptom of endocrine imbalance rather than an entity.

One or more glands of the endocrine system may be a causative factor of thyroid disturbance which may be synergistic, or depressant.

Several cases of thyrotoxicosis have been reported that were cured by x-ray treatment to the pituitary, ovaries, or suprarenals, giving little or no attention to the thyroid.

Almost all cases considered had x-radiation to some part of the endocrine chain, and frequently endocrine substances were employed as an aid.

Many endocrinologists have been consulted, many of whom consider surgery as a very faulty step in the correction of thyrotoxicosis.

To adhere to the idea that thyrotoxicosis is always a surgical entity, instead of a symptom, shows our disregard for, or our ignorance of, scientific development. It is Wolfe's idea that, to treat the thyroid as an entity, shows that *living men think dead men's thoughts and pursue dead men's ideals, mere ghosts of belief—ideals from which time has sapped all substance and meaning.*

The adherence to the beaten path indicates that we are engulfed by a *dogma which we, the living, receive as a command from the dead.*

The endocrine system lends itself so freely to the use of x-rays and our biologicals serve so well in many cases, that I feel a new epoch is dawning in the handling of thyrotoxicosis, when x-radiation will supersede surgical interference.

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DISCUSSION

I. WARNER JENKINS, M.D. (*closing*): I wish to thank Dr. McConnell¹ for his liberal and enthusiastic discussion, and pay my sincere respects to my critics (who have many times forced my back to the wall), whose relentless opposition to my efforts in radiation therapy of the thyroid syndrome has served as a stimulus as no other medium could have done.

¹ Not returned for publication.

Laboratory experiments have produced overwhelming evidence as to the inter-relationship of the ductless gland system. The stubbornness of some of my cases to yield to x-ray treatment, and the recurrence of thyroids surgically treated by others, argued, to me, that the thyroid was not always primarily to blame.

To accept goiter as always an entity is

to disregard proven fields in laboratory experimentations.

Certainly, I have sent some of my non-toxic pressure cases to surgery, some have been medical, but, for the most part, x-ray applied by one trained in radiology, to whatever gland or glands that are in the hookup, is by all means the method of choice in handling thyrotoxicosis.

CASE REPORT

GASTROCOLIC FISTULA

By WILBUR BAILEY, M.D., and WILLIAM V. KNOLL, M.D., *Los Angeles, California*

Fistulous tracts, directly between the colon and stomach, and between the colon and stomach by way of the jejunum, are infrequent but not rare. Although the diagnosis is sometimes not difficult, the symptoms of the underlying primary disease may overshadow the effects produced by the fistula, and because the symptoms are often intermittent in nature, even a radiological examination may not immediately yield a definite diagnosis. Verbrugge (7), in 1925, collected 216 cases from the literature. Recently, Fardelmann (3) col-

of carcinoma of the stomach in two, and of the colon in three, of the 12 cases. This closely approaches the averages elsewhere reported. In recent years, however, as the popularity of gastro-enterostomy for the treatment of peptic ulcer has grown, the complication of gastro-jejuno-colic fistula originating from perforating gastrojejunal ulcers has been occurring with increasing frequency (Figs. 1, 2, and 3).

Although cancer and gastrojejunal ulcers are the most common causes, any disease which weakens the stomach wall in the proper location may cause the production of a fistulous tract. Simple gastric ulcer, although we have one case in a female, is usually considered a rare cause, largely, we suspect, because most gastric

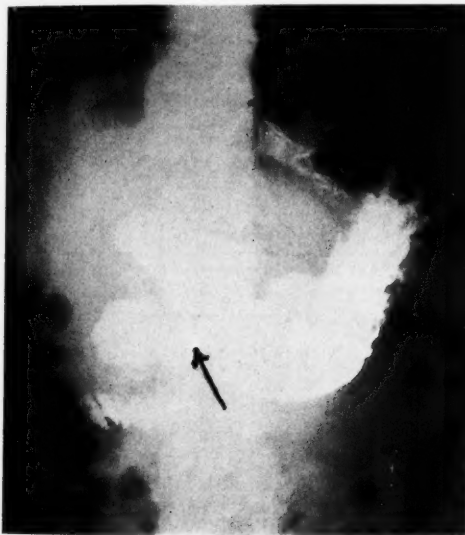


Fig. 1.

Fig. 1. Gastro-jejuno-colic fistula (arrow). Patient had Billroth II operation for perforated gastric ulcer six years previously. Perforation occurred again despite the fistula, and the patient died.



Fig. 2.

Fig. 2. Gastro-jejuno-colic fistula (arrows). Gastro-enterostomy ten years previously, followed by marginal ulcer. The patient now has profuse diarrhea. Barium enema.

lected 13 more cases that have occurred since 1925. In the last ten years there have been 12 cases at the Los Angeles County General Hospital, all of which were proven by radiological, surgical, or postmortem examination. From this material we have chosen illustrative cases.

Etiology.—That carcinoma of the stomach or colon is still one of the most likely causes of gastrocolic fistula is indicated by the presence

ulcers along the greater curvature where they would be in a position to cause such a fistula, are malignant, and hence would be classified under the heading of carcinoma. Abdominal tuberculosis, peritoneal abscess, and trauma are potential causes. A fistulous perforation into the stomach from the transverse colon has recently been described as a complication of ulcerative colitis (1).

The fistulous tract differs in mode of origin

according to the underlying lesion. In carcinoma of the stomach or colon the fistula constitutes part of the tumor which, after direct extension to the adjacent colon or stomach, undergoes necrotic change. The origin of a

gastrojejunal or jejunal ulcers which perforated into the peritoneum.

Age and Sex.—The ages varied from 37 to 65 years. Of particular interest was the presence of one female in the series, because only one



Fig. 3.

Fig. 3. Gastro-jejuno-colic fistula (arrow). Gastro-enterostomy eight years previously. Large stoma closed surgically. Barium enema.



Fig. 4.

Fig. 4. Gastro-jejuno-colic fistula following gastro-enterostomy. Only a few colonic haustra were filled (below arrow) by barium-meal examination.

fistula following gastro-enterostomy is somewhat different. Primarily, the patient upon whom the gastro-enterostomy is performed, usually already has a peptic ulcer in the stomach or—more likely—in the duodenum. Following the gastro-enterostomy an ulcer develops at or near the stoma. All such ulcers tend to perforate, but if they become plastered against the wall of the colon the resulting perforation results in a gastrocolic fistula. According to the usual description, the formation of a fistula represents the end-result of a perforating jejunal ulcer, and healing ensues "with fistula edges as clean as though made surgically." That the ulcer may continue to be active and perforate further, however, is indicated by one of our cases in which, after development of the fistula, the patient died of peritonitis from perforation of the jejunal ulcer into the peritoneum. It is interesting to note that Thompson (6) found, from a study of the same material which we used (5), cases of

case of gastrocolic fistula has previously been reported in a female. Our patient was an Indian who had a subacute nephritis. Her fistula resulted from the perforation of a simple gastric ulcer into the transverse colon.

Symptoms.—A rigid dividing line between the symptoms produced by the original gastric or colonic lesion and the subsequent gastrocolic fistula cannot always be drawn. Thus, five cases in the series were caused by carcinoma of the stomach or colon, and the symptoms which first presented were themselves attributable to the carcinoma. Likewise, the early symptoms of the seven peptic ulcer cases were characteristic of the original lesions. Some cases presented an insidious chronic picture while others had previously given a history of acute perforation. Six of them had had a posterior gastro-enterostomy of from four to 21 years' duration.

The secondary symptoms are those directly traceable to the presence of the fistula. The onset may be insidious. They are:

1. Diarrhea: A profuse intractable diarrhea was common to all the "gastro-enterostomy" cases and frequent in the carcinoma group. Although often intermittent in the beginning, the diarrhea rapidly progressed to

4. Pain: Most of the patients complained of epigastric distress or pain which varied from a dull sensation to acute attacks of considerable severity. Inasmuch as the pain may often arise from the underlying carcinoma or ulcer,

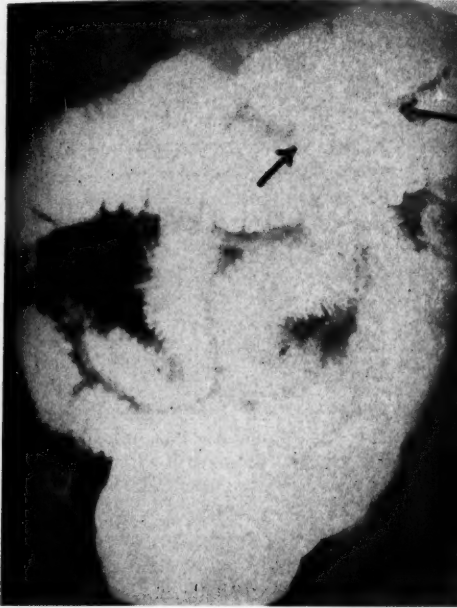


Fig. 5.

Fig. 5. Same case as shown in Figure 4. The stomach filled promptly *via* the fistula (arrows) at barium-enema examination.



Fig. 6.

Fig. 6. Gastrocolic fistula after gastro-enterostomy (arrow). Note contracted transverse colon and ragged appearance of the descending colon, indicating inflammatory irritation from stomach contents.

from eight to ten movements a day with one case reaching 30. The movements sometimes occurred as promptly as ten minutes after the ingestion of food. Undigested food particles were easily recognizable in the often foul and usually light-colored stools. Free fat, because of insufficient action of the pancreatic juice, as well occasionally as free hydrochloric acid, could be found.

2. Eructation and Vomiting: Fecal vomiting in the absence of obstructive symptoms is pathognomonic. Eructation of foul gas is the rule, but may escape the attention of the patient and physician.

3. Weight Loss: All of the patients lost weight, the usual amount being from 20 to 30 pounds, with the loss in one case reaching 80 pounds in a year. For the most part, the weight loss and the diarrhea were contemporaneous and commensurate. Dehydration was the rule, not the exception.

it is not dependable as a diagnostic sign of fistula.

5. Secondary Effects: Generalized edema of the "nutritional" type (5), night blindness from failure of the digestive tract to absorb sufficient vitamin A, as described by Wilbur (8), and similar deficiency symptoms are occasionally encountered.

Differential Diagnosis.—The severe diarrhea is often the outstanding symptom and if there is an accompanying fever, as in some of the carcinoma cases, typhoid fever may be suspected. Likewise dysentery, ulcerative colitis, and sprue (2) may wrongly be considered as the cause of the diarrhea. The fact that the diarrhea is sometimes intermittent may add to the difficulty of making a clear diagnosis of gastrocolic fistula. The loss of weight may wrongly be ascribed entirely to carcinoma of the stomach unless the diarrhea is properly interpreted. Secondary effects such as general edema, similar to the so-called "nutritional

edema," or other symptoms resulting from deficient absorption may be presenting symptoms which overshadow the diarrhea.

Radiological Examination.—Although the history, stool examination, or enemas or meals containing colored substances may be of help, a satisfactory radiological examination is of prime importance in establishing the diagnosis and determining the cause of the gastrocolic fistula.

The fistulous tracts as shown in some of the autopsied cases of our series were sometimes small, meandering, irregular passages. It is not remarkable, therefore, that on occasion these passages may be blocked by mucous membrane folds, food particles, or by the edema caused by a concomitant inflammatory process. Rare instances of spontaneous healing have been reported. Usually, however, the diarrhea—after a remission—again recurs.

From the radiologic standpoint these characteristics of the fistulous tract are of great importance for they explain why a gastrocolic fistula may not be detected at certain stages, or why a barium enema may readily show the connection, while the barium meal—apparently because of a valve-like mechanism—will not show any abnormality. Of our cases there were three in which the gastrocolic fistula was demonstrated by the barium enema, but not by the barium meal (Figs. 4 and 5).

Although the actual tract in the carcinoma cases is often readily demonstrated, in the gastro-enterostomy cases the connection is usually not visible for two reasons. The first is that 75 per cent of all gastrojejunal ulcers are at the stoma (4) and, hence, the fistulous tract has very little actual length: the second, because the barium may follow any one of three pathways. It may go through the duodenum and thence promptly fill the jejunum, or it may follow the gastro-enterostomy, or may go directly into the colon. Because of this "three-ring-circus effect," the actual connecting segment is usually covered by barium-filled bowel before it can be detected.

The highly irritating gastric contents may cause inflammatory changes in the mucous membrane of the colon (Fig. 6) which closely resemble those of ulcerative colitis, and a perforation from ulcerative colitis may, there-

fore, be suspected as the cause of the gastrocolic fistula.

Prognosis.—The prognosis is grave in cases unoperated upon. Operation is made difficult because of the numerous defects in bowel walls which must be repaired and the danger of contamination from colon contents. In our 12 cases including the five carcinomas, all patients except two were dead within a month after admission. These two had had surgical intervention. Many of the others were considered too ill for surgery.

CONCLUSIONS

1. Gastrocolic fistula occurs most frequently as a complication of gastrojejunostomy or because of perforations of stomach or colon carcinoma.
2. The outstanding symptoms are intractable diarrhea with loss of weight and dehydration.
3. Radiologic examination is the best method of demonstrating these fistulous tracts, but because their irregular walls sometimes exert a valve-like action, either the barium meal or barium enema alone is not sufficient to rule out the presence of such a fistula. Of the two methods the barium enema is more likely to show the abnormal passage.

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THE ECONOMIC STATUS OF THE RADIOLOGIST UNDER SOCIALIZED MEDICINE:

A Report on Germany¹

In Germany the health of the individual is controlled by the government from the cradle to the grave. Socialized medicine in some form has been in effect in that country since 1883. At the beginning it was a system of sickness insurance for certain groups and occupations. During the intervening years so many social and medical conditions have arisen and so many controlling laws enacted that today it is a very complicated system. The tendency has been to abolish the establishment of separate funds and to care for the masses on a wage-earning or income basis. The benefits to be paid to a workman during illness; his care and that of his immediate family; the premiums to be paid for such service, and the class of care to be given are all regulated by law.

In Germany at the present time there are four kinds of health insurance:

1. The community or local obligatory insurance (*Orts-und Betriebskrankenkassen*).
2. The obligatory commercial health insurance (*Ersatzkassen*).
3. The private insurance companies (*Privat-krankenkassen*).
4. The welfare authorities (*Wohlfahrts-ämter*).

The welfare authorities are not insurance companies in the proper sense of the word, but are institutions supported by the State or community funds for the treatment of the poor. The funds used for the care of the poor are derived from taxes and donations and are similar to welfare disbursements in America. The individuals receiving benefits do not contribute or pay premiums as in the case of the insured persons, in other words such benefits are purely charity.

All employed persons who earn 300 marks and less a month are legally obliged to be members of one of the health insurance companies (mentioned under 1 and 2, above). The com-

mmercial insurance companies are entitled to admit members of the commercial professions only. The commercial members can choose between the first two forms of insurances.

With an income above 3,600 marks a year, it is understood that a person can afford to pay for his medical services or has saved enough to care for himself or members of his family in event of a catastrophic illness. Due to the income stipulation for employed person and with a fairly high income bracket, it is compulsory for the greater part of the wage-earning population to carry some form of health insurance.

The obligatory insurance is regulated by the government and in each community is the local, or *Orts Krankenkassen*. Private insurance companies promoted by private capital are as strictly controlled by the government regulations as are the other types of health insurance.

The private insurance companies—*Privat-krankenkassen*—admit all persons who wish to have an insurance protection against diseases, independent of their monthly income. Members of the private companies are also various other persons, such as the state and community officers of the lower classes and such persons as independent workmen and, therefore, not admitted to the legal health insurance, although they have an income of less than 300 marks per month. In addition, those wealthy persons who wish to have health insurance may obtain a policy from the private companies. Therefore, many of those of moderate means who may do so belong to the *Krankenkassen*. In a way it is only the wealthy and those who do not care to purchase protection that are to be found without insurance.

The premiums are different in different classes, and according to the premiums the disbursements in money are also different. It is usual that in the higher classes not more than 80 per cent of the doctor's bills are paid to the members or subscribers. In this way the companies avoid a too frequent calling of the physician by the patient. The amount for hospitalization, operations, x-ray examinations, x-ray treatment, etc., is paid in full in the highest

¹ Prepared at the request of the Inter-Society Committee for Radiology by S. W. Donaldson, M.D., Ann Arbor, Mich.

contribution class and only in percentages in the lower classes.

The affairs of the local *Orts* are administered by a committee, who are elected, so that of the group two-thirds represent the employees and one-third the employers. This committee must see that each *Orts* is self-supporting and that the money received is sufficient to pay all salaries, benefits, fees, disbursements, administration costs, and to provide for buildings and their upkeep.

Patients under the health insurance scheme are allowed to select their doctor or hospital. When one becomes a member of one of the obligatory insurance plans he is furnished with an alphabetical list of physicians and specialists in his community. If the patient does not consult one of the approved physicians, then he must pay the bill himself. Ward class hospital care is provided; if he prefers better accommodations, he must pay the difference, and if he prefers a private physician then that fee must also be paid by the patient. In case of illness or injury the insured must obtain from the *Krankenkassen* a permit or sickness slip (for which he pays a separate fee) and this slip authorizes the physician to render service. The contracts provide for a specified number of weeks of medical or hospital care each year. There are approximately 7,000 approved *Krankenkassen* in operation in Germany at the present time.

The financial scheme of the sick was devised after a study of the cost of medical care. Since its inception the premium paid by each worker from his monthly income has varied from below 2 per cent to over 6 per cent. At the present time it is about 3.5 per cent-4 per cent. One-half of this premium or contribution is paid by the employer and one-half by the employee. The average contribution for a wage earner up to 300 marks a month is 3 per cent and, for those with a higher salary, the average contribution is accordingly higher. That is, a sliding scale prevails as it pertains to the income, the contribution, and to the benefits.

Thus about 80 per cent of the entire population are subscribers to some form of health insurance. The medical treatment for these subscribers and all accommodations in the ward class of the hospitals including operations, x-ray examinations, and treatments are free.

The remuneration paid to those doctors who are admitted to the legal and obligatory health

insurances (*Krankenkassen*) is a very small one. A physician can make only a modest living from such work and must see many patients a day and obviously has little time for study or recreation.

The obligatory commercial health insurance plans (*Ersatzkassen*) pay a little more, and thus the physician who has many commercial employees as patients can expect to better his income.

The private health insurance companies (*Privat-krankenkassen*) do not pay to the physician directly, but only to the members. They demand from the members that the physician's bills must be balanced by the patient himself before they give any compensation. The company allows the member 80 per cent of the total amount and the patient pays the other 20 per cent; as stated above, this procedure tends to discourage the patient from too many visits to his doctor.

All of the health insurance companies are strictly controlled by the government and a special authority (*Reichsversicherungsamt*) has been set up for this purpose.

Any approved physician is entitled to make x-ray examinations for the purpose of a first orientation. This is especially true in regard to fluoroscopic surveys. A special commission made up of radiologists has the power of extending to general practitioners the privilege of making roentgenograms. This commission also investigates the qualifications of the specialist. This commission considers his professional education, his special training, and his equipment. It also passes upon his qualifications to administer roentgen therapy, and, in addition, may test the accuracy of his instruments for the measurement of dosage. In addition to its duties of determining the qualifications of men seeking to enter the field of roentgenology, it has control of the settlement of accounts of the radiologists for services rendered to health insurance patients.

The commission is entitled to approve diagnosis and the quality of films. This is intended to avoid inferior work by recognized radiologists, and to improve or eliminate those men who show insufficient training. This control commission, organized by the radiologists, in a way guarantees that the insurance companies pay only for a high grade of work. The radiologists feel that it has been advantageous to them in that it has upheld the grade of work accepted by the insurance companies,

and they, in turn, realize that they can well afford to pay reasonable fees as long as a high standard is maintained. In all cases it has been desirable to have a representative of the insurance company as a member of such a commission.

Specialists are entitled to make x-ray examinations and to administer x-ray therapy in their specialty only, such as, the surgeon is not allowed to examine a stomach, the dermatologist may give only superficial therapy, etc. All deep therapy must be administered by an approved radiologist.

In Germany there are four sources of roentgenological consultation available to all physicians:

1. *The Central X-ray Departments in the Large Hospitals.*—All patients of all departments of the hospital are examined or treated in these central departments under the direction of some prominent roentgenologist and his assistants.

2. *Special X-ray Departments in the Different Branches or Departments of the University Clinics and Some Big Hospitals.*—Such departments are not so numerous as generally believed and a great deal of their time is devoted to research. By dismembering radiology as a unit and establishing a unit for each specialty, there is a tendency to develop specialists within a specialty. Such a situation is probably inevitable in very large departments.

3. *The Central X-ray Department of Some of the Large Public Health Insurances (Krankenkassen).*—The insurance companies exert pressure upon their members to go to these institutions, and in this manner constitute the greatest competition to the private roentgenologist and to the x-ray departments of the hospitals.

4. *The Roentgenologist with a Private Office and, at the Same Time, Possibly in Charge of the X-ray Department of One of the Smaller Hospitals on a Part-time Basis.*—The private office practices exist only in the cities and large metropolitan centers, as a small town could not support such a practice. The ability to show a profit in such an office is directly dependent upon the number of patients. The small fees paid by the public health insurance groups are sufficient to maintain a private x-ray practice, if a minimum number of 150 patients monthly are examined or treated. If as many as 300 patients are seen each month, then a profit can be expected. The earnings of a

private office practice having more than 300 patients monthly are sufficient for a profit and also a reasonable renewal of equipment and the purchase of additional improvements. Offices with less than 300 patients monthly will have considerable difficulty in respect to purchasing new equipment or replacing old and obsolete machines unless the greatest economy is exercised and excellent care given to the equipment already installed.

The greatest competition for the private x-ray office lies in the radiological departments of the local or community health insurance organizations. As all x-ray work must be agreed to by these organizations before it can be carried out, it is necessary for the patient to go to the large and modern buildings which have been built, the *Orts*, or local insurance company. This gives them the opportunity to urge the patient to go to the so-called "*Eigenbetrieben*," e.g., the proper department.

The compensation for the radiologist's hospital work is often a fixed salary from 400 to 800 marks per month and in some of the larger institutions a higher salary is paid. In smaller departments the radiologist gets a percentage of the receipts, usually after a deduction of a certain rate for the cost of films, chemicals, and other overhead expenses.

For the diagnostic x-ray service as well as for therapy there are regulations which determine the amount of fluoroscopy allowed or the number and size of the films to be made for every condition. These restrictions have been made to prevent unnecessary films and to require the radiologists to be extremely economical. In case the radiologist deems it necessary to make additional exposures and use more than the allotted number of films in order to arrive at a diagnosis, he must do so at his own expense, or give special reasons why more than the allotted number of films was necessary. The radiologist must have a large number of patients in order to absorb any deficit occurring in such a manner.

The German Roentgen Society (*Deutsche Roentgenengesellschaft*) has agreed upon rates for the expenses incident to each examination and these figures are the bases of the different tariffs. The German Roentgen Society is consulted by the authorities in all difficult economical questions pertaining to roentgen diagnosis or roentgen therapy. A close co-operation between the radiologists and the prac-

tioners is urged and desired, and it may be said that it exists in most cases from a medical viewpoint, but in matters of economics their interests are sometimes divergent.

There are two main tariffs for radiology in Germany: the "*Preussische Gebuehrenordnung*" (Preugo) and the "*Allgemeine Deutsche Gebuehrenordnung*" (Adgo). The "Preugo" distinguishes a rate for costs of films, material, etc., and a rate for the radiologist's fee, including the report. The rate for the costs is different, according to the size of the films used.

Size: 9×12 cm., 13×18 cm., 18×24 cm., 24×40 cm., 30×40 cm., Fluoroscopy.

Marks: 3.0, 4.50, 5.20, 6.0, 7.75, 3.25.

The fee for the radiologist is 5.0 marks for the first exposure or, as termed, application of the x-ray apparatus, and 3.35 for the second and subsequent applications up to five during the same examination. A few examples of the method used in submitting charges as allowed are as follows:

Complete Examination of the Chest.—One fluoroscopy and one film 30×40 cm. For this is paid 7.75 marks for the film and 3.25 marks for the fluoroscopy, making a total of 11.00 marks for expenses, and, in addition, the radiologist receives a fee of 5.0 marks for the first application (filming the patient) and 3.35 marks for the second application during the same examination, or a total of 19.35, or, at the present rate of exchange of approximately 40 cents a mark, the equivalent of \$7.65.

Complete Gastro-intestinal Examination.—Three fluoroscopies are allowed and, at most, two 18×24 cm. films and one 24×30 cm. film, making a total of five applications of the x-ray apparatus. The fee for this is 21.75 marks and the expenses paid are 25.35 marks, making a total for the examination of 47.10 marks. A complete examination with the above number of films and fee is paid only in complicated cases. The total fee for the average gastro-intestinal examination is about 35.0 marks.

Gall-bladder Examination.—Two 18×24 cm. films and one 24×30 cm. film; fee 11.75 and expenses 15.60 marks for a total of 27.35 marks.

Examination of the Knee Joint.—Two exposures on one 24×30 film; fee 8.35 and expenses 11.00 marks or a total for the examination of 19.35 marks.

Examination of the Hand.—Two exposures on one 13×18 cm. film; fee 8.35 and expenses 4.50, total 12.85 marks.

The "Adgo" has only a so-called "organ tariff" which is higher than the "Preugo." This tariff provides a fixed payment for examination of the different organs, for example: Lungs, 28 marks; stomach and duodenum, 35 marks; complete gastro-intestinal, 50 marks; wrist, 15 marks. This tariff is paid by all commercial obligatory insurance organizations (*Ersatzkassen*). A complete examination, including fluoroscopies and report, is to be furnished for these rates, independent of the number of films used or number of applications of the x-ray apparatus.

For radiation therapy the "Preugo" and the "Adgo" distinguish between superficial and deep therapy. The regulations for therapy are as follows: In superficial therapy the fee paid is per area. The fee paid is for the treatment of one field with the so-called effective dose, irrespective of the number of applications or "sittings" or the filtration used. The fee paid per area is for irradiation of that area, 5.0 marks plus 5.0 marks for expenses. The maximum size of an area is 17×17 cm. and six areas are paid for in every single disease. A large amount of superficial therapy is carried out by the dermatologists in their own offices and, because of these innumerable treatments, the tariff has been made low: 10 marks per field in the "Preugo" and 15 marks in the "Adgo."

For deep therapy, only allowed to be carried out by approved radiologists, the "Adgo" pays somewhat more than the "Preugo"; for instance, a complete treatment for cancer of the uterus costs approximately 135 marks in the "Preugo" and 155 marks in the "Adgo." Deep therapy charges depend upon the effective dose. In carcinoma of the uterus the fee amounts to 100 marks and the expenses allowed are 35 marks. The effective depth dose for such a treatment is set at 2,500 r.

The prices for work done by private radiological offices correspond in general with the prices of the "Adgo." Only a few prominent radiologists get more. In cases of legal proceedings the "Preugo" is taken as the basis for discussion by the authorities.

A new general German tariff for all medical work has long since been announced by the present medical authorities, but it has not yet gone into effect. According to the best private information available, the fees for radiology will be between the prices now in force in the "Adgo" and the "Preugo."

The radiologists have no direct settlement with the patients whose insurance is compulsory. The settlements with the legal insurance companies go by way of an organization which is directed by physicians. All receipts of the obligatory insurance organizations are carefully checked by the controlling medical organization to see whether the individual physician exceeds the average of other physicians in his bill, both as to amount charged and to the amount of work done. Reductions occur in all cases in which the amount of the physician's bill is too high.

The medical organization pays to the radiologists as well as to all practising physicians a round sum which is derived from the amount paid in by the members of the insurance company. Payments are made every quarter and a final settlement is made at the end of the last quarter of the next year. At the time of the final settlement, if a difference exists between what the physician has been paid and what is due to him, he is credited with the amount due him or, if overpaid, that amount is charged against him.

In preparing the schedule of expenses all existing costs such as films, chemicals, a percentage of rent, technicians' salaries, depreciation on equipment, and minor overhead expenses were given consideration.

Every physician is obliged to give exact reports about his patients. A report is transmitted to the insurance company, one to the examining board, and one must be retained by the radiologist. The following information must be sent on each patient to the commission which settles the account, or the bills submitted to them by the radiologist:

1. Name, Christian name, age of the patient.
2. Statement of the disease.
3. Kind of radiologic treatment. If diagnostic services were rendered, the number of fluoroscopies as well as the number and size of the films must be included. If therapy, then the number of irradiations and the total r dosage must be given.
4. The roentgen diagnosis.
5. Name and address of the referring physician.
6. Calculation of charges divided into expenses and fee.

In summary of this report it may be said that the following important factors show the

present set-up of the economic status of the radiologist in Germany:

(1) All employed persons in Germany with an average monthly income of less than 300 marks must be in an obligatory insurance organization.

(2) All other persons can buy a policy of a private insurance company protecting them in case of illness or disease. The compensations paid are dependent upon the contribution or premiums paid into the company.

(3) About 80 per cent of the population of Germany is in one of the various insurance schemes.

(4) The radiologist is paid according to two different tariffs, the "Adgo" and the "Preugo."

(5) The profit-making ability of a private x-ray practice is strictly dependent upon the average number of patients each month. The minimum number is considered to be 150.

(6) The greatest competition is that of the x-ray departments of the obligatory insurance companies.

(7) Radiology is practised in Germany by central x-ray institutes, special x-ray departments, private offices, and the x-ray departments in the general hospitals.

(8) Payments for radiological services are made by a special commission of radiologists who supervise the qualifications of those desiring to practise radiology, and audit all accounts submitted.

Germany to-day has a very large proportion of the population under a strictly regulated socialized medical scheme. The paper work, and as termed in this country "red tape," is a tremendous task, although probably not as much as for the occasional WPA case seen by the private practitioner in this country.

As has been shown, the minimum number of patients per month necessary for operation of an x-ray office at a profit is 150. In view of this fact it is interesting to make comparisons of the fees allowed in Germany, and the present fee schedule was adjusted and arranged in consultation with the German Roentgen Society, with the fee schedule adopted and put into effect in this country by the CWA and carried on to the WPA. Considering the present rate of exchange of .40 cents for the mark, the fee allowed under socialized medicine in Germany for the x-ray examination of a hand is \$5.14 and the WPA allowance (if claim is not disallowed) is \$2.50. For a knee the fee is \$7.74, and WPA \$2.50; a chest \$7.65 as

against \$3.75, and for a complete gastro-intestinal \$18.84 as compared to \$12.50. Undoubtedly the experience of the German system since its introduction has produced better cost accounting in the matter of radiologic examinations than that used by the authorities who suggested the CWA and WPA fee schedule for such services.

It is easy to see that the administration costs of operating such a system of socialized medicine are great. The fees paid to the general practitioner must, of necessity, be low in order to pay the physicians on salary, the nursing staff, druggists, and lay clerical help. An enormous sum is already invested in the buildings and equipment, and maintenance costs and replacements must be taken from the money paid in by the workers. It, therefore, stands to reason that, in order to meet the administration costs and pay

salaries to the large number of employees, very little is left to be apportioned to the physicians for their professional services. It is needless to say that the specialist fares better than the practitioner under such a system.

There are lessons to be learned from the experiences of the German radiologists and it is sincerely hoped that even in this short report there is enough material to give the American radiologist some food for thought upon the question of government control of the practice of medicine.

I wish to thank those radiologists in Germany who were kind enough to give me economic information and also to thank Dr. Marum, of Greenville, Miss., and Dr. Seilmann, of New York City, for their suggestions and criticisms in the preparation of this report.

S. W. D.

RADIOLOGICAL SOCIETIES IN THE UNITED STATES

Editor's Note.—Will secretaries of societies please cooperate with the Editor by supplying him with information for this section? Please send such information to Leon J. Menville, M.D., 1201 Maison Blanche Bldg., New Orleans, La.

CALIFORNIA

California Medical Association, Section on Radiology.—Chairman, Karl M. Bonoff, M.D., 1930 Wilshire Blvd., Los Angeles; *Vice-president*, Carl D. Benninghoven, M.D., 95 S. El Camino Real, San Mateo.

Los Angeles County Medical Association, Radiological Section.—President, E. N. Liljedahl, M.D., 1322 North Vermont Ave., Los Angeles; *Vice-president*, M. L. Pindell, M.D., 670 South Ferris Ave.; *Secretary*, Wilbur Bailey, M.D., 2007 Wilshire Blvd.; *Treasurer*, Henry Snure, M.D., 1414 South Hope Street. Meets every second Wednesday of each month at County Society Building.

Pacific Roentgen Club.—Chairman, Lyell C. Kinney, M.D., San Diego; *Secretary*, L. Henry Garland, M.D., 450 Sutter Street, San Francisco. Executive Committee meets quarterly; Club meets annually during annual session of the California Medical Association.

San Francisco Radiological Society.—Secretary, L. H. Garland, M.D., 450 Sutter Street. Meets monthly on first Monday at 7:45 P.M., alternately at Toland Hall and Lane Hall.

COLORADO

Denver Radiological Club.—President, F. B. Stephenson, 452 Metropolitan Bldg.; *Vice-president*, K. D. A. Allen, M.D., 452 Metropolitan Bldg.; *Secretary*, E. A. Schmidt, M.D., 4200 E. Ninth Ave.; *Treasurer*, H. P. Brandenburg, M.D., 155 Metropolitan Bldg. Meets third Tuesday of each month at homes of members.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Chairman, Ralph T. Ogden, M.D., 179 Allyn St., Hartford; *Secretary-Treasurer*, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings twice annually in May and September.

DELAWARE

Affiliated with Philadelphia Roentgen Ray Society.

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Florida Radiological Society.—President, H. O. Brown, M.D., 404 First National Bank Bldg., Tampa;

Vice-president, H. B. McEuen, M.D., 126 W. Adams St., Jacksonville; *Secretary-Treasurer*, J. H. Lucinian, M.D., 168 S. E. 1st St., Miami.

GEORGIA

Georgia Radiological Society.—President, James J. Clark, M.D., Doctors Bldg., Atlanta; *Vice-president*, William F. Lake, M.D., Medical Arts Bldg., Atlanta; *Secretary-Treasurer*, Robert C. Pendergrass, M.D., Prather Clinic, Americus. Meetings twice annually, in November and at the annual meeting of the Medical Association of Georgia in the spring.

ILLINOIS

Chicago Roentgen Society.—President, David S. Beilin, M.D., 411 Garfield Ave.; *Vice-president*, Chester J. Challenger, M.D., 3117 Logan Blvd.; *Secretary-Treasurer*, Roe J. Maier, M.D., 7752 Halsted St. Meets second Thursday of each month, September to May, except December.

Illinois Radiological Society.—President, Cesare Gianturco, M.D., 602 W. University Ave., Urbana; *Vice-president*, Fred H. Decker, M.D., 802 Peoria Life Bldg., Peoria; *Secretary-Treasurer*, Edmund P. Halley, M.D., 968 Citizens Bldg., Decatur. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—The next meeting will be May 2, 3, 4, 1939, to be held in Rockford. The officers of the Section for the coming meeting are Harry B. Magee, M.D., of Peoria, *Chairman*, and Warren W. Furey, M.D., 6844 Oglesby Ave., Chicago, *Secretary*.

INDIANA

Indiana Roentgen Society.—President, Stanley Clark, M.D., 108 N. Main St., South Bend; *President-elect*, Juan Rodriguez, M.D., 2903 Fairfield Ave., Fort Wayne; *Vice-president*, A. C. Holley, M.D., Attica; *Secretary-Treasurer*, Clifford C. Taylor, M.D., 23 E. Ohio St., Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

MAINE

See New England Roentgen Ray Society.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Chairman, Whitmer B. Firor, M.D., 1100 N. Charles St.; *Secretary*, Walter L. Kilby, M.D., 101 W. Read St. Meetings third Tuesday of each month.

MASSACHUSETTS

See New England Roentgen Ray Society.

MICHIGAN

Detroit X-ray and Radium Society.—President, Sam W. Donaldson, M.D., 326 N. Ingalls St., Ann Arbor;

Vice-president, Clarence Hufford, M.D., 421 Michigan Ave., Toledo, Ohio; *Secretary-Treasurer*, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave.

Michigan Association of Roentgenologists.—President, E. R. Witwer, M.D., Harper Hospital, Detroit; *Vice-president*, D. W. Patterson, M.D., 622 Huron Street, Port Huron; *Secretary-Treasurer*, C. K. Hasley, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—President, Walter H. Ude, M.D., 78 S. 9th St., Minneapolis; *Vice-president*, Leo G. Rigler, M.D., University Hospitals, Minneapolis; *Secretary-Treasurer*, Harry Weber, M.D., 102 Second Ave., S. W., Rochester. Meetings quarterly.

MISSOURI

The Kansas City Radiological Society.—President, L. G. Allen, M.D., 907 N. 7th St. Kansas City, Mo.; *Secretary*, Ira H. Lockwood, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—President, Paul C. Schnobelen, M.D.; *Secretary*, W. K. Mueller, M.D., University Club Bldg. Meets on fourth Wednesday of October, January, March, and May, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—President, T. T. Harris, M.D., Clarkson Memorial Hospital, Omaha; *Secretary*, D. Arnold Dowell, M.D., 117 S. 17th St., Omaha. Meetings first Wednesday of each month at 6 P.M. in Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY

(Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island.) *President*, Frank E. Wheatley, M.D., 520 Beacon St., Boston; *Secretary*, E. C. Vogt, M.D., 300 Longwood Ave., Boston. Meetings third Friday of each month from October to May, inclusive, usually at Boston Medical Library.

NEW HAMPSHIRE

See New England Roentgen Ray Society.

NEW JERSEY

Radiological Society of New Jersey.—President, Milton Friedman, M.D., 31 Lincoln Park, Newark; *Vice-president*, P. S. Avery, M.D., 546 Central Ave., Bound Brook; *Secretary*, W. James Marquis, M.D., 198 Clinton Ave., Newark; *Treasurer*, James Boyes, M.D., 744 Watchung Ave., Plainfield. Meetings at Atlantic City at time of State Medical Society, and Midwinter in Newark as called by president.

NEW YORK

Brooklyn Roentgen Ray Society.—President, Albert Voltz, M.D., 115-120 Myrtle Avenue, Richmond Hill; *Vice-president*, A. L. L. Bell, M.D., Long Island

College Hospital, Henry, Pacific, and Amity Sts., Brooklyn; *Secretary-Treasurer*, E. Mendelson, M.D., 132 Parkside Ave., Brooklyn. Meetings first Tuesday in each month at place designated by president.

Buffalo Radiological Society.—President, Walter Mattick, M.D., 101 High St.; *Vice-president*, Chester Moses, M.D., 333 Linwood Ave.; *Secretary-Treasurer*, J. S. Gian-Franceschi, M.D., 610 Niagara Street. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen-ray Society.—President, W. E. Achilles, M.D., 60 Seneca St., Geneva; *Vice-president*, M. T. Powers, M.D., 250 Genesee St., Utica; *Secretary-Treasurer*, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings held in January, May, and October as called by Executive Committee.

Long Island Radiological Society.—President, Samuel G. Schenck, M.D., Brooklyn; *Vice-president*, G. Henry Koiransky, M.D., Long Island City; *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn; *Treasurer*, Louis Goldfarb, M.D., 608 Ocean Ave., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—President, Raymond W. Lewis, M.D., 321 E. 42nd St., New York City; *Vice-president*, Henry K. Taylor, M.D., 667 Madison Ave., New York City; *Secretary*, Roy D. Duckworth, M.D., 170 Maple Ave., White Plains; *Treasurer*, Eric J. Ryan, M.D., St. Luke's Hospital, New York City; *Member of Executive Committee*, E. Forrest Merrill, M.D., 30 W. 59th St., New York City. Meetings third Monday evening each month at Academy of Medicine.

Rochester Roentgen-ray Society.—Chairman, Joseph H. Green, M.D., 277 Alexander St.; *Secretary*, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

Associated Radiologists of New York, Inc.—President, Albert L. Voltz, M.D., 115-120 Myrtle Ave., Richmond Hill; *Vice-president*, M. M. Pomeranz, M.D., 911 Park Ave., New York City; *Secretary*, W. J. Francis, M.D., 121 Madison Ave., New York City; *Treasurer*, Theodore West, M.D., United Hospital, Port Chester. Meetings first Monday evening each month at McAlpin Hotel.

NORTH CAROLINA

Radiological Society of North Carolina.—President, Robert P. Noble, M.D., 127 W. Hargett St., Raleigh; *Vice-president*, A. L. Daughtridge, M.D., 144 Coast Line St., Rocky Mount; *Secretary-Treasurer*, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meetings with State meeting in May, and meeting in October.

OHIO

Cleveland Radiological Society.—President, John Heberding, M.D., St. Elizabeth's Hospital, Youngstown; *Vice-president*, R. V. May, M.D., St. Luke's Hospital, Cleveland; *Secretary-Treasurer*, Harry Hauser, M.D., City Hospital, Cleveland. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—President, B. M. Warne, M.D., Doctors Building, Cincinnati; *Secretary-Treasurer*, Justin E. McCarthy, M.D., 707 Race St., Cincinnati, Ohio. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—President, Charles S. Caldwell, M.D., 520 S. Aiken Ave., Pittsburgh; *First Vice-president*, Thomas L. Smyth, M.D., 111 N. 8th St., Allentown; *Second Vice-president*, Reuben G. Alley, M.D., Western Pennsylvania Hospital, Pittsburgh; *Secretary-Treasurer*, Lloyd E. Wurster, M.D., 416 Pine St., Williamsport; *President-elect*, Louis A. Milkman, M.D., 212 Medical Arts Bldg., Scranton; *Editor*, William E. Reiley, M.D., Clearfield. Annual meeting, May, 1939. Exact date and place to be decided.

Philadelphia Roentgen Ray Society.—President, Thomas P. Laughery, M.D., Germantown Hospital; *Vice-president*, Elwood E. Downs, M.D., Jeans Hospital, Fox Chase; *Secretary*, Barton H. Young, M.D., Temple University Hospital; *Treasurer*, R. Manges Smith, M.D., Jefferson Hospital. Meetings first Thursday of each month from October to May, Thompson Hall, College of Physicians, 19 S. 22nd St., 8:15 P.M.

The Pittsburgh Roentgen Society.—President, William B. Ray, M.D., 320 E. North Avenue, N. S. Pittsburgh; *Secretary*, Harold W. Jacox, M.D., 4800 Friendship Ave. Meetings held second Wednesday of each month at 4:30 P.M., from October to June at various hospitals designated by program committee.

RHODE ISLAND

See New England Roentgen Ray Society.

SOUTH CAROLINA

South Carolina X-ray Society.—President, Percy D. Hay, Jr., M.D., McLeod Infirmary, Florence; *Secretary-Treasurer*, Hillyer Rudisill, Jr., M.D., Roper Hospital, Charleston. Meetings in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

SOUTH DAKOTA

Meets with Minnesota Radiological Society.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee State Radiological Society.—President, S. S. Marchbanks, M.D., 508 Medical Arts Bldg., Chattanooga; *Vice-president*, Steve W. Coley, M.D., Methodist Hospital, Memphis; *Secretary-Treasurer*, Franklin B. Bogart, M.D., 311 Medical Arts Bldg., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—President, Jerome H. Smith, M.D., San Antonio; *President-elect*, C. F. Crain, M.D., Corpus Christi; *First Vice-president*, M. H. Glover, M.D., Wichita Falls; *Second Vice-president*, G. D. Carlson, M.D., Dallas; *Secretary-Treasurer*, Henry C. Harrell, M.D., 517 Pine St., Texarkana. Meets annually. Temple is place of next meeting

VERMONT

See New England Roentgen Ray Society.

VIRGINIA

Radiological Society of Virginia.—President, Fred M. Hodges, M.D., 100 W. Franklin St., Richmond; *Vice-president*, L. F. Magruder, M.D., Raleigh and College Aves., Norfolk; *Secretary*, V. W. Archer, M.D., University of Virginia Hospital, Charlottesville.

WASHINGTON

Washington State Radiological Society.—President, H. E. Nichols, M.D., Stimson Bldg., Seattle; *Secretary*, T. T. Dawson, M.D., Fourth and Pike Bldg., Seattle. Meetings fourth Monday of each month at College Club.

WISCONSIN

Milwaukee Roentgen Ray Society.—President, H. W. Hefke, M.D.; *Vice-president*, Frederick C. Christensen, M.D.; *Secretary-Treasurer*, Irving I. Cowan, M.D., Mount Sinai Hospital, Milwaukee. Meets monthly on first Friday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—*Secretary*, Russel F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September

University of Wisconsin Radiological Conference.—*Secretary*, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor*

HOWARD P. DOUB, M.D., *Associate Editor*

RADIATION THERAPY AND GLANDS OF INTERNAL SECRETION

Investigations and experimental observations in recent years in the field of medical research have obtained valuable information concerning the function and effects upon the human body of the glands of internal secretion, and this knowledge has opened another important field for radiation therapy. Its principal use has been in functional disturbances of the thyroid, parathyroid, pituitary, ovary, adrenals, breast disturbances, and bone dyscrasias.

This form of therapy is not new, since for over twenty years radiation therapy has been applied to the pituitary gland for various gynecological conditions, and recently this form of therapy has been given to this organ in certain cases of diabetes mellitus and so-called essential hypertension. While favorable results have been obtained with this type of therapy, there arose the question as to whether therapeutic doses of x-ray can influence non-adenomatous pituitary glands. Recently, Lawrence, Nelson, and Wilson, of Yale University, answered the question by certain experimental work on the radiation of the pituitary gland of female albino rats. These investigators believe that their experiments suggest that non-adenomatous human hypophyses can be influenced by therapeutic doses of the roentgen ray.

Lacassagne conducted certain experiments on female animals by destroying their hypophyses with radium and observing the effect on their ovaries, which showed considerable changes. One-third of the anterior lobe suffices to preserve the usual genital activities, even if the remainder of the anterior and the entire middle and posterior lobes are completely destroyed. Many years ago, Biedl and Aschner showed that extirpation of the anterior lobe of the pituitary in young animals produced atrophy of the ovaries and uterus. The same result was produced by Gellar by intensive roentgen-ray radiation of the pituitary. The work of Dixon and Marshall established definitely the inter-relationship between the pituitary and the ovary.

It is interesting to note that Tierney and Engelbach believe that both subjectively and objectively the function of the pituitary gland is dualistic. Thus, disease of the gland may cause amenorrhea, dysmenorrhea, epileptiform attacks, obesity, headaches, definite changes in the osseous, genital, and dermal systems, increased blood pressure, fever, and involuntary muscular contractions.

While the effects and results obtained by radiation of the pituitary gland are well known, similar knowledge concerning the adrenals is less well understood, particularly as it concerns blood pressure. There have been numerous reports from investigators who maintain that the adrenals are not affected by therapeutic doses of roentgen ray. The experimental work of Cottenot, Frey, Pozzi, Stephan, and Strauss would appear to confirm this. On the other hand, the work of Zimmern and Baude offers a logical explanation of the results of roentgen-ray therapy to the adrenals. They believe that the normal adrenals are unaffected by therapeutic doses of x-ray in the same manner as the normal thyroid, but when adrenals are in a stage of hyperactivity, they respond in a similar manner to the hyperactive thyroid. However, they are of the opinion that the favorable results they obtained in radiating the adrenals for hypertension may have been due to an effect on the vegetative nervous system rather than on the adrenals. As far back as 27 years ago, investigations were made by Zimmern and Cottenot on the effect of radiation on the adrenals in human subjects with hypertension with favorable results.

Two years after Zimmern and Cottenot's observations, Eisler and Hirsch conducted certain experiments by destroying several rats with excessive doses of roentgen rays. They removed the adrenals soon after death and made an extract in physiological saline solution. They made a similar extract from the adrenals of unirradiated rats. They injected these extracts into the jugular veins of rabbits, while

the blood pressure was registered in the carotid. In the instance wherein the irradiation extract was injected, the blood pressure rose rapidly, but in a short time returned to normal. In the instance of the unirradiated extract, the rise in blood pressure was the same, but the elevation remained for a long time. Thus it would seem that radiation therapy over the adrenals does affect blood pressure.

Then, again, we find that the adrenals have been irradiated in cases of diabetes mellitus. Desplats, Langeron, and Bera used roentgen therapy over the adrenals in patients with diabetes mellitus. They report a diminution of sugar in the blood and urine. They believe that this reduction in sugar, provided that there is sufficient insulin in the blood, is explained on the basis of arterial dilation. The vegetative nervous system, being affected by this form of therapy, allows a better blood supply to the blood vessels of the muscles, producing an increased muscular combustion of blood sugar. It may be that the effect of roentgen rays on the vegetative nerves may be a direct one, since Langeron and his co-workers found an increase in the amount of urine immediately after roentgen therapy and before the sugar elimination was diminished. Then again, Desplats reports a case of diabetes mellitus that had arterial obliteration of the limbs in the form of intermittent claudication that was greatly improved with roentgen therapy over the region of the adrenals. Zimmern experienced the same findings. From these and similar observations, there are some who believe that perhaps the pituitary and adrenals are responsible for certain cases of essential hypertension, and also believe that they secrete a substance, when in a stage of hyperfunction, which produces hypertension and hyperglycemia. The application of radiation therapy to these glands will affect the hypertension and hyperglycemia.

The application of radiation to the pituitary in menopausal disturbances was first used by Werner, in 1923. In many quarters it is believed that as the pituitary becomes hyperactive the ovary becomes less active, and that aggravated menopausal syndromes are due to overactivity of the pituitary. Splendid results have been reported of the use of radiation therapy to the pituitary, not alone for menopausal syndromes, but also for menstrual deficiencies. This form of therapy is safe, when applied by a radiologist, for Borak cites that for the past thirty years children have been treated for tinea capitis with similar technical

factors and that no sign of damage to the hypophysis or brain tissue has ever been observed.

Certain experimental observations that have been reported concerning changes produced in the ovaries when the thyroid gland was radiated, seem to explain the known clinical fact that radiation therapy over the thyroid will stimulate ovarian function. In further substantiation of this fact, Coret states that disturbances of menstruation, oligomenorrhea, and amenorrhea, as is sometimes found in exophthalmic goiter, are explained as direct response to thyroid dysfunction. Then again, many favorable reports have been made concerning radiation therapy to the pituitary in cases of goiter which failed to respond to this form of therapy when applied only to the thyroid gland.

While it is true that roentgen therapy has been employed frequently for the relief of endocrine disturbances, and in certain instances proven more effective than the hormones themselves, we must not permit our enthusiasm to cause us to overestimate its value and make unreasonable predictions. A warning should be sounded to inexperienced physicians, owners of x-ray apparatus, against the indiscriminate use of radiation therapy in all cases of hypertension. Not only would such a practice occasion a distrusting attitude on the part of the physicians who refer their cases for therapy, but considerable harm to the patient might be the result. When applied judiciously and intelligently by an experienced radiologist, this form of therapy will prove of inestimable value in certain cases of hypertension, menopausal syndromes, and menstrual deficiencies, without producing any damage to the organ treated. We should ever remember that the success of a physician is based upon his skill and judgment, and not upon any particular agency by means of which he practises medicine.

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COMMUNICATION

PROMOTION OF A FRIEND

The Editor begs to convey the following information, and to congratulate Mr. Cyrus S. Fleck upon his management of the highly technical business of printing RADIOLOGY. He was elected, in January, to the office of Executive Vice-president of the printing firm which holds the contract.

BOOK REVIEW

OUTLINE OF ROENTGEN DIAGNOSIS. An Orientation in the Basic Principles of Diagnosis by the Roentgen Method. By LEO G. RIGLER, B.S., M.B., M.D., Professor of Radiology, University of Minnesota. Atlas Edition. A volume containing 266 pages, and 254 illustrations. Published by J. B.

Lippincott Company, Philadelphia, 1938. Price: \$6.50.

For several years Doctor Rigler's notes concerning his lectures on roentgen diagnosis have been available in mimeograph form to his students at the University of Minnesota. Their popularity because of the concise presentation of the subject has spread to other institutions and the appearance of the revised notes in a more formal dress will be welcomed by teachers and students. The publication is available in two forms, one containing only the outline and index and the other, an atlas edition, in which the notes are supplemented by 227 figures including drawings and reproductions of roentgenograms. The author has used a new type of drawing instead of roentgenograms to illustrate many skeletal conditions. In a book of this sort, where cost to students is an important consideration, this may be necessary, but even though the drawings are of high quality they fail to portray the same information that is conveyed by a first-quality roentgenogram properly reproduced by modern printing methods. The bibliography is limited to 15 suggested text-books, which may be sufficient for the usual medical undergraduate—the post-graduate student, however, will find it inadequate.

On the whole, the author has produced an excellent synopsis of a rapidly growing subject. The arrangement is such that it should fit into most organized didactic courses concerning this specialty and therefore will be popular with undergraduate students. From the standpoint of the post-graduate, it is a cold academic presentation of basic facts that lacks the color of personal information based on a large amount of experience.

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ARTHRITIS

Massive Doses of Vitamin D in Chronic Arthritis: Its Effect on Calcium Metabolism. Charles LeRoy Steinberg. *Jour. Lab. and Clin. Med.*, **24**, 17-24, October, 1938.

Daily, 160,000 U.S.P. units of Vitamin D were administered to 40 cases of chronic arthritis. Clinical improvement was noted in 35 per cent of the total number treated; 65 per cent were unimproved.

Initial serum calcium and phosphorus determinations were made in 32 cases. A detailed determination of calcium and phosphorus was carried out in 12 of the treated cases, varying in periods of from three weeks to one and one-half years.

The author found that such vitamin therapy would lower a high serum calcium; that it would raise a low or normal serum calcium to a higher level, and then, after continued administration, would again decrease the hypercalcemia level. The clinical improvement or non-improvement, or even aggravation of existing joint symptoms, had no bearing on the change of blood calcium. The effect on the serum phosphorus was less marked.

From such a study one may conclude that the effect of massive doses of Vitamin D in chronic arthritis is non-specific, and that the improvement noted with this medication would fall in line with many other non-specific remedies employed in the treatment of this disease.

W. A. WARD, M.D.

BACKACHE

Hypertrophy of the Ligamentum Flavum as a Factor in the Production of Low Back and Sciatic Pain. Walter D. Abbott. *Jour. Iowa St. Med. Soc.*, **28**, 266-271, July, 1938.

When there is a history of trauma followed in the course of a few weeks up to one to two years by low back pain with radiation in the distribution of one or both sciatic nerves, loss of sensation or strength, and absence of the Achilles reflex, hypertrophy of the ligamentum flavum must be considered. These ligaments stretch across the postero-lateral aspect of the spinal canal between the laminae. They are, normally, from one to four millimeters thick; when hypertrophied they may measure up to one or two centimeters in thickness. The etiological factor generally is trauma, although in some cases an inflammatory process may be the initiating factor. The history in most instances is that of injury to the back following lifting or falling. Upon the injection of lipiodol a notching of the shadow or in some cases a complete block may be present when the patient is observed in the supine position. Six brief case reports are presented together with illustrations of the conditions found at operation and photographs of removed specimens.

L. W. PAUL, M.D.

Displacement of the Intervertebral Cartilage as a Cause of Back Pain and Sciatica. Edgar F. Fincher and Exum B. Walker. *South. Med. Jour.*, **31**, 520-526, May, 1938.

Herniated intervertebral disk, with spinal nerve root compression, should be borne in mind as a cause of back strain and pain.

The symptomatology consists of a radiating pain exaggerated by sneezing, coughing, or any activity momentarily raising the spinal fluid pressure; muscle spasm sufficient to straighten the normal lumbar curvature; limitation of motion such as straight-leg lifting; "listing" of the body, and variable neurologic findings.

X-ray studies are made both preliminary to and after injection of 5 c.c. of iodized oil into the subarachnoid space with fluoroscopy of the patient prone on a tilted table. A pathologic defect is visualized on at least three occasions before final diagnosis is made.

A quantitative protein determination on the first 2 c.c. of spinal fluid removed is a valuable aid in diagnosis. In almost every instance it is increased over forty milligrams per cubic centimeter.

The treatment advanced is laminectomy and removal of the herniation.

JOHN M. MILES, M.D.

BONE DISEASES (DIAGNOSIS)

Rare Disturbances of Osseous-cartilaginous Growth. F. Holldack. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, **58**, 1-18, July, 1938.

Two cases of rare disturbance of osseous-cartilaginous growth are discussed. The first case is classified as chondro-dysplasia, the second as chondro-dystrophy.

Chondro-dysplasia is interpreted as a congenital skeletal disease, characterized by irregularity and delay in ossification of the intermediary cartilage. Cartilaginous tissue, on which normal longitudinal growth of bones depends, does not undergo the normal process of ossification. Cartilage preserves its structure unduly long and, persisting in such form, gradually creates more or less voluminous masses, which frequently require abnormally long periods for transformation into osseous tissue. Simultaneously, one can encounter in the long tubular bones, particularly in the metaphyses, osteo-cartilaginous tumors which may be located subperiosteally or intramedullary, and produce tumorous swelling of the bone. They transform para-epiphyseal, osseous segments into transparent, voluminous masses. The epiphysis persists as more or less cartilaginous structure, producing less osseous substance than a normal epiphysis at the same age. As a result of such proliferation in the regions of osseous growth, diaphyses and metaphyses may undergo considerable deformity.

The second case is characterized by a disturbance in ossification of normal epi- and apo-physal anlage, apparent roentgenologically by lack of lime substance and punctate transparencies of the involved skeletal

portions. Gradually, a bilateral coxa vara developed as a static deformity. Other skeletal parts are not involved by any gross deformity. Skeletal length is absolutely normal as is also the mutual relationship of component parts. Initially, classification of this case to any one of the well established clinical entities, particularly dyschondroplasia and achondroplasia, was not simple. Dyschondroplasia was ruled out in the absence of any disturbance in length and any deformity by cartilaginous proliferation.

A plea is made for a more logical classification of many a typical chondro-dystrophies, and a rather extensive discussion of the literature favors classification of many atypical disturbances of bony development under this title. Even Kashin-Beck's disease and osteo-arthritis might be considered under this classification.

H. A. JARRE, M.D.

Hodgkin's Disease of the Bones. Herman S. Lieberman. *Jour. Bone and Joint Surg.*, **20**, 1039-1044, October, 1938.

The author presents a case of Hodgkin's disease primary in the lumbar vertebrae. A complete history and clinical findings are presented.

JOHN B. McANENY, M.D.

Sarcoidosis: Report of a Case. Wyndham B. Blanton. *South. Med. Jour.*, **31**, 26-29, January, 1938.

A case of sarcoidosis is reported in a woman 27 years of age. The disease is interesting because of its characteristic bone changes and of its rarity. The case reported varies somewhat from the usual. The typical punched-out rarefied areas are present in the carpal bones, metacarpals, and phalanges, but there is also an associated arthritis of four years' standing. Skin lesions, nodules, infiltrations, etc., are absent in this instance. The microscopic appearance of the lymph nodes, although presenting the typical epithelioid cells with large vesicular nuclei, suggests earlier changes than have been observed previously.

JOHN M. MILES, M.D.

BONE DISEASES (THERAPY)

Oseous Dystrophy of the von Recklinghausen Type. M. Deluen. *Bull. et mém. Soc. de Radiol. méd. de France*, **26**, 257, 258, April, 1938.

The clinical and roentgenographic features of a case of von Recklinghausen's disease are presented. The case was benefitted by roentgen therapy to the region of a fracture of the tibia.

S. R. BEATTY, M.D.

Roentgen Therapy in Acute Osteoporosis. E. B. Mumford. *Jour. Bone and Joint Surg.*, **20**, 949-959, October, 1938.

Results here reported of radiation therapy of Sudeck's acute bone atrophy are very encouraging. The charac-

teristic atrophy appears shortly after injury in those parts composed of small bones and multiple joints. It is followed later by severe pain which is not relieved by heat or rest. In the film, the cortex is preserved but the medulla is mottled and the longitudinal trabeculae are indistinct.

Five of six cases treated received prompt relief and early function. The manner of action of the treatment cannot be explained. The technic used is with a tube output of 173 kw. (173 kv.?) at 6 ma., 0.5 mm. Cu + 1 mm. Al, from 30 to 40 cm. distance. Two or three treatments of from 150 to 200 r were given every two to three days for three treatments. The treatment can be repeated after six weeks, and again after two months.

JOHN B. McANENY, M.D.

Roentgen Therapy of Paget's Disease of Bone. R. Ledoux-Lebard. *Bull. et Mém. Soc. de Radiol. Méd. de France*, **26**, 161, 162, March, 1938.

In the author's experience of 17 cases, roentgen therapy has not only relieved the pain of the bone lesions of Paget's disease in all but one, who received only one series of treatments, but also, in many of these cases, has caused some degree of recalcification.

His technic: 200 kv., 0.5 mm. Cu + 2 mm. Al filtration, 800 r given in weekly doses of 200 r for one series. Frequently relief follows the first series, infrequently two or three at intervals of six months are necessary, and relief from pain may last from several months up to years.

S. R. BEATTY, M.D.

Giant-cell Tumor of Bone. Bradley L. Coley and Norman L. Higinbotham. *Jour. Bone and Joint Surg.*, **20**, 870-884, October, 1938.

This excellent presentation of experience in the treatment of giant-cell tumors accentuates several important points: the value of roentgenography and of biopsy in diagnosis; the occasional occurrence of malignant change and treatment. The findings of the authors lead them to believe that surgery and irradiation each has its place in treatment, the former showing the greater percentage of excellent end-results. The two types of treatment should never be used together as it is then that the greatest number of amputations follow.

JOHN B. McANENY, M.D.

BONES, TUMORS

The Roentgen Diagnosis and Treatment of Benign Giant-cell Tumor of the Bone. J. A. Meadows and K. F. Kesmodel. *South. Med. Jour.*, **31**, 148-153, February, 1938.

Two types of benign giant-cell tumor are considered: a trabeculated and a non-trabeculated or "lysis" type. Eleven cases are reported. The treatment varies: if progressive calcification occurs, sub-erythema doses

are continued at from four- to six-week intervals; if new areas of destruction appear, heavier dosage is given.

From this experience the authors believe that the trabeculated type responds well to radiation therapy; that some giant-cell tumors heal or are arrested spontaneously, and that the non-trabeculated type should be treated, not only with x-ray, but also with surgery.

JOHN M. MILES, M.D.

Bone Tumors. C. A. Hellwig and C. H. Warfield. *Jour. Kansas Med. Soc.*, **39**, 302, 303, July, 1938.

Based on the facts collected by the Registry of Bone Sarcoma, the authors have prepared a chart showing the salient features of the various bone tumors and allied conditions. For each type of tumor are given the age incidence, sites of predilection, symptoms, x-ray findings, treatment, pathological picture, and prognosis.

L. W. PAUL, M.D.

Bone Tumors. George J. McChesney, Robert L. Carroll, and Kenneth S. Davis. *Calif. and West. Med.*, **49**, 64-68, July, 1938.

The clinical discussion of bone tumors by the above-named authorities is well worth reading. It describes clearly and comprehensively the symptoms, diagnosis, and treatment of these puzzling lesions.

JAMES J. CLARK, M.D.

THE BREAST

Roentgenologic Examination of the Normal Breast: Its Evaluation in Demonstrating Early Neoplastic Changes. J. Gershon-Cohen and Albert Strickler. *Am. Jour. Roentgenol. and Rad. Ther.*, **40**, 189-201, August, 1938.

A good description of the embryology, post-natal, and puberal development, anatomy, and menstrual changes of the normal breast is given.

Roentgen examinations were made on 142 normal girls and women—one study near the onset of menstruation, and another after an interval of fourteen days. The technic of examination is described in detail. The average factors used were 32 kv., 100 ma., 0.3 sec., 36 inches distance and par speed screens.

The roentgen findings were analyzed in relation to the menstrual, pregnant, and lactational history; age, height, and weight; previous breast operations and anomalies or derangements of the endocrine system. The authors state that they do not believe that the roentgenogram could give information concerning such changes as benign epitheliosis and adenosis, which make their appearance during puberty. The diagnosis of early neoplastic processes in the adult breast is complicated by intricate tissue architecture.

The roentgen examination of the breast, to be of real aid to the clinician, must reveal the pathologic changes in their earliest stages. The authors state that changes in, and addition to, the present roentgen technic may

make the examination more valuable. The roentgenologist should have a thorough and comprehensive knowledge of the roentgen appearance of the normal breast under all conditions of growth and physiologic activity.

IRVING I. COWAN, M.D.

The Roentgen Visualization and Diagnosis of Breast Lesions by Means of Contrast Media. N. Frederick Hicken, R. Russell Best, Howard B. Hunt, and T. T. Harris. *Am. Jour. Roentgenol. and Rad. Ther.*, **39**, 321-343, March, 1938.

An accurate study of the breast substance can be made by contrast media, of which thorotrast and CO₂ have been found to be the best.

Technic.—Under aseptic conditions from 1 to 2 c.c. of thorotrast is injected into the milk duct or ducts in question. After completion of the examination the substance is aspirated. If CO₂ is used, it is injected both into the pre-mammary and retro-mammary tissues. The CO₂ is absorbed in 15 minutes. Films are taken stereoscopically.

Diagnosis.—With visualization of the anatomical arrangement of the milk ducts and secretory mechanism, lipoma, fibroma, papilloma, cysts, galactoceles, and carcinoma have been diagnosed. In general, the malignant lesions show destruction and invasion, whereas the benign merely displace the normal structures. With the CO₂ aeromammogram, the lesion can be demonstrated as encapsulated or attached to the neighboring structures.

In a series of 625 mammograms only three abscesses have occurred, each following accidental extravasation of thorotrast into the periductal tissues. The only contra-indication of this type of study is acute mastitis.

S. M. ATKINS, M.D.

Extensive Calcifications in the Breast. Anton Kubat. *Röntgenpraxis*, **10**, 689, 690, October, 1938.

Extensive calcifications of the breast were noted in a roentgenogram of a 78-year-old woman with Paget's disease. The roentgenologic literature available to the author did not give any reference to such a finding.

Calcifications in the breasts might be found after a mastitis, tuberculosis of a breast, or, most commonly, in adenomas.

In this case they were thought to be calcium deposits in multiple adenomas (bilateral, multiplicity, and structure).

HANS W. HEFKE, M.D.

CALCULI

The Radiological Aspect of the Treatment of Ureteric Calculus. D. G. Maitland. *Med. Jour. Australia*, **2**, 38-40, July 9, 1938.

The radiologic investigation of the urinary tract may be listed as plain radiography, retrograde pyelography and pneumo-pyelography, and excretion pyelography.

A good film must show the kidney outlined and it must be free from extraneous shadows. All movement due to respiration must be eliminated since even slight respiratory movements may obliterate the shadow of a small calculus. Calculi composed of calcium oxalate cast a dense shadow, those composed of calcium phosphate cast a slightly less dense shadow, while those composed of xanthin or uric acid may cast no shadow, and, therefore, be invisible in a plain radiogram, even though they may be quite large. Large cystin stones easily cast a faint shadow but small ones are not apparent.

The author states that excretion pyelography depends upon the facility of the kidneys to excrete urea, since this substance is the vehicle by which the contrast substance passes through the kidneys. Excretion pyelography should be reserved for identification of shadows; the determination of the intrarenal or urinary situation of shadows; the approximate differential renal function, and the demonstration of coincident disease or anomaly in one or both kidneys. In discussing the differential diagnosis of various shadows which may occur upon a film, the author makes the following statement: Branched shadows superimposed over the kidney outline offer no difficulty, but shadows toward the peripheral and renal outline may be calculi, calcified tuberculous foci, calcified lymph glands, semi-organized blood clot, the necrotic areas of a suppurative pyelonephrosis, or even calcified areas sometimes found in hypernephroma or teratoma.

A calcified concretion in the tip of the appendix may simulate a right ureteric calculus. The retroperitoneal gland may be very difficult to differentiate.

W. H. GILLENTE, M.D.

Calculus of the Bladder in a Case Previously Treated for Cancer of the Cervix. T. Nogier. *Bull. et mém. Soc. de Radiol. Méd. de France*, 8, 113, 114, February, 1938.

A woman treated intensively two years previously for carcinoma of the cervix developed suprapubic pain and hematuria. The pelvic examination revealed only a mass in the vesico-vaginal region, shown by cystoscopy to be a large bladder calculus.

S. R. BEATTY, M.D.

CANCER (DIAGNOSIS)

Primary Carcinoma of the Biliary System: A Clinico-pathological Analysis of 40 Cases. Rigney D'Aunoy, Michael Alexander Ogden, and Béla Halpert. *Surg.*, 3, 670-678, May, 1938.

The study is based on 40 cases from 6,050 autopsies at Charity Hospital, New Orleans, from Jan. 1, 1931, to Oct. 6, 1937. Twenty-three were primary in the liver, six in the extra-hepatic biliary ducts, and 11 in the gall bladder. Twenty of the patients were white (12 male, eight female) and 20 were colored (18 male, two female). One died in the second decade;

three in the fourth; eight in the fifth; 11 in the sixth; 14 in the seventh, and three in the eighth.

Of the 23 primary liver neoplasms, 16 were liver-cell, and seven were cylindrical-cell growths. All were primary in the extra-hepatic biliary ducts, and those in the gall bladder were cylindrical-cell growths.

In addition to local infiltration or spread by lymph or blood channels, there were metastases to regional lymph nodes and distant organs.

The majority of the cases of primary liver growths were jaundiced, all with growths of the extra-hepatic ducts were jaundiced, and most of the primary growths of the gall bladder were associated with jaundice and cholelithiasis.

The illness lasted for from two to 16 months, with an average duration of four and one-half months.

JOHN E. WHITELEATHER, M.D.

Two Cases of Gastric Cancer: The Difficulty of the Radio-diagnosis of Lesions of the Pyloric Antrum. P. Vasselle. *Arch. d. mal. de l'app. digestif*, 28, 166-174, February, 1938.

The diagnosis of pre-pyloric carcinoma is often difficult, as frequently the deformity is very slight, and at other times the element of spasm is predominant and persistent, simulating a lesion of some extent when actually a small lesion or none at all exists. Two illustrative cases are presented.

S. R. BEATTY, M.D.

CANCER (THERAPY)

The Treatment of Carcinoma of the Cervix Uteri. Ralph E. Myers. *Jour. Okla. St. Med. Jour.*, 31, 74-78, March, 1938.

The treatment of cervical carcinoma is wholly a radiological problem, but we are far from the point where we can be content with our results. Leading radiologists agree that the treatment should be continuous, somewhat protracted, and very intensive. The chances of a cure or of good palliation depend on the first series of treatment.

The author favors occasional moderate doses of radium, interspersed in the x-ray treatment, from ten days to two weeks after treatment is instituted. A specimen is removed for microscopic study. In questionable cases the microscopic study is made first.

A 34 per cent five-year cure is reported in a group of 32 cases, including Groups 1-4.

JOHN M. MILES, M.D.

Treatment of Skin Malignancy by Irradiation. Harold W. Jacox. *Pennsylvania Med. Jour.*, 41, 1126-1129, September, 1938.

Early skin cancer may be treated by electrosurgery, cautery, or irradiation.

Irradiation treatment is divided into three types: (1) selective active type in which the tumor is sensitive, as a basal-cell carcinoma, (2) caustic action, and (3) fractional irradiation.

For lesions up to 5 cm. in diameter, from 85 to 135 kv. of unfiltered irradiation is used. Basal-cell lesions are given at least 4,000 r in a series; squamous-cell at least 5,000 r; lesions 2 cm. thick, from 7,000 to 8,000 r. Larger lesions and those involving bone and cartilage are given from 100 to 300 r per day using 200 kv., highly filtered, until tissue tolerance (3,500 to 6,000 r) is given. Highly filtered gamma rays of radium in doses of from 200 to 500 milligram-hours contact, or 1,600 milligram-hours at 1 cm. distance may also be used. Radium has the advantage in non-ulcerating lesions. Case reports are given to illustrate the different technics the author describes in his article.

JOSEPH T. DANZER, M.D.

Results Obtained in Radiation Treatment of Inoperable Collum Carcinoma. Ivan de Büben. *Am. Jour. Roentgenol. and Rad. Ther.*, **40**, 264-268, August, 1938.

The author studied 702 cases of inoperable collum carcinoma which were treated by irradiation during the ten years from 1919 to 1929, at Women's Clinic No. 1, in Budapest.

The method of treatment used combined radium and roentgen rays. A combination of vaginal and cervical application of radium was carried out with the dosage ranging from 4,000 to 6,000 mg.-hr. The treatment time was distributed over several weeks. Roentgen rays were applied externally, using from three to six fields and giving 1,500 r per field. Factors used were 190 kv., 5 ma., filter of 0.5 mm. Zn plus 0.5 mm. Al, 30 cm. skin-target distance.

There were 405 cases of five-year cures (that is, absence of symptoms) out of the 702 cases studied. Of these 405 cases under observation for five years, 38, or 9.3 per cent, were completely cured, and 43.1 per cent were symptom-free for at least one year.

IRVING I. COWAN, M.D.

Carcinoma of the Cervix and Breast: Prognosis and Preferable Therapy. Edward D. Greenberger. *Jour. Okla. St. Med. Assn.*, **31**, 79-82, March, 1938.

Carcinoma of the cervix is classified clinically into Groups 1-4, according to the extent of the disease. Seventy-five per cent of all cases fall in Groups 3-4 and have a poor prognosis as to a five-year cure.

Radium is applied with a colpostat and a tandem in the uterus. The total dose varies from 2,000 to 4,000 mg.-hr. around the cervix, and from 3,000 to 6,000 mg.-hr. within the uterus. The Regaud technic is employed, giving small doses of radium continuously for from four to seven days.

X-ray therapy consists of from 150 to 200 r every other day to one of from three to six portals until from 1,200 to 2,500 r per portal have been given to the pelvis.

For Groups 1-2 cases, radium is applied first, followed by x-ray in a month or six weeks. For Groups 3-4, especially if pelvic infection is present, x-ray is given first, and often repeated two months after radium therapy.

Carcinoma of the breast is classified into three groups. In Group 1 the tumor is movable and confined to the breast. Surgery results in a cure in from 50 to 80 per cent of these cases, and irradiation plays a minor rôle. In Group 2 the tumor is movable and there are but few axillary metastases. Post-operative irradiation improves the percentage of five-year cures and reduces the number of local recurrences. Pre-operative irradiation employing doses of from 1,800 to 2,400 r to each of from three to four portals offers much promise in destroying the more sensitive cancer cells, confining the field of the growth, and preventing surgical transplantation. Operation is performed six or eight weeks later. In Group 3 there is diffuse involvement of the breast and extensive metastases. Operation is to be avoided.

JOHN M. MILES, M.D.

Cervical Lymph Nodes in Intra-oral Carcinoma: Surgery or Irradiation? James J. Duffy. *Am. Jour. Roentgenol. and Rad. Ther.*, **39**, 767-777, May, 1938.

Surgery offers a better chance of cure in the operable group of carcinomas of this type, whereas in advanced stages radiation will produce a greater chance for at least a longer and more comfortable life.

Before surgery is instituted all of the following indications must be present: primary lesion controlled, limited to one side of the oral cavity and consisting of highly differentiated cells; cervical metastases limited to one group of nodes, or nodes in two contiguous cervical triangles; capsule of nodes not invaded; opposite side of the neck free of metastases; no distant metastases, and the general condition of the patient good.

Contra-indication to surgical treatment, except in the advanced cases in which no treatment is of avail, is an indication for radiation.

These conclusions are drawn from a study of 252 cases of carcinoma of the lateral border of the tongue, which may serve as examples of all oral lesions except those of the lip.

S. M. ATKINS, M.D.

Treatment of Carcinoma in the Pharynx and Larynx and its Results. Lionel Colledge. *British Med. Jour.*, **2**, 167, 168, July 23, 1938.

Results of irradiation, according to this author, are neither so good as to supplant surgery nor so bad as to be discarded. The implication is that it is optional which method is used. The discussion is limited to epithelioma from the surgical standpoint. (Such is the author's statement and intention, though the subject of radiation appears prominently.)

In epithelioma of the oropharynx, the larger the neck glands are, the smaller is the primary growth. Early growths may be removed by diathermy. Advanced infiltrating growths necessitate the removal of the mandible (here the author suggests, somewhat contradictorily, that the use of radon seeds is the most attractive method of attack). For tumors of the

lower pharynx, laryngectomy is advised. Until recent years, radiation of lower pharyngeal tumors with successful results was almost negligible. Intrinsic carcinoma of the larynx is now best treated by radium beam.

Abstractor's note: This article appeals to me as a demonstration of a good surgeon unconsciously admitting considerable value to methods other than his own.

Q. B. CORAY, M.D.

Early Results in Cervix Carcinoma from Single and Divided Doses of Roentgen Radiation. A. N. Arneson. *South. Med. Jour.*, **31**, 21-26, January, 1938.

A comparison is made of the early results of single exposures of x-rays to each of from four to six pelvic fields with the results obtained by using protracted multiple exposures. The single exposure method is found to be of little value in producing any effect upon the disease. The divided dose treatment is, therefore, recommended.

The author uses from four to six pelvic fields, 15 X 10 cm., 200 kv. p., 0.5 mm. copper filter, and gives from 200 to 400 r daily until from 1,200 to 2,000 r have been given to each portal. The smaller dose is used when there are extensive diseases and poor physical condition. In this manner from two to three threshold doses reach the diseased area, while in the single exposure method less than one threshold dose is delivered. Less than three threshold doses are relatively ineffective in controlling cervical carcinoma.

Radium therapy augments the x-ray therapy and should be given within two weeks of the completion of the x-ray treatment. Radium fails to deliver lethal tumor beyond three or four centimeters. Careful and individual planning of both radium and x-ray therapy is necessary if present clinical results are to be improved.

JOHN M. MILES, M.D.

THE COLON

Roentgen Kymography of the Normal Colon: Defecation in Man. Richard A. Rendich and Leo A. Harrington. *Am. Jour. Roentgenol. and Rad. Ther.*, **40**, 173-179, August, 1938.

The authors discuss the physiology of the colon as shown by various experimental methods. They studied the act of defecation in 39 male patients having apparently normal colons and of these 15 were kymographed. The authors' preliminary conclusions are as follows:

1. The colon and rectum move downward about 12 mm. when increase of abdominal pressure occurs.
2. There is elongation and narrowing of the rectum during evacuation, with relaxation of the anal sphincter.
3. The findings suggest that colon evacuation may be stimulated reflexly from the rectum since the rectal and anal changes seem to precede the motion in the colon.

4. When propulsion is definitely advanced the contraction of segments of the lower bowel varies irregularly with inactive segments. This segmented contraction of the circular fibers is shallow and seems to resemble a systolic and diastolic phase rather than a peristaltic wave.

5. The plicae transversalis recti are probably concerned with intrinsic rectal tonus rather than an expulsive function.

The authors suggest that kymographic studies of constipation may reveal some useful information.

IRVING I. COWAN, M.D.

Cancer of the Transverse Colon of Masked Type. A. Cade and M. Milhaud. *Jour. de méd. de Lyon*, **18**, 447-452, Aug. 20, 1937.

Cancer of the transverse colon offers certain diagnostic difficulties. It is less common than those of the ascending portion and sigmoid, and the symptomatology is frequently atypical or misleading. Symptoms of pseudo-hepatic type frequently mask the true picture, as in the case reported by the authors, in which a complex clinical picture and a history of malaria and dysenteric infection obscured the true diagnosis, made only at autopsy. It is in these cases that repeated, thorough, roentgenologic examination, using barium enemas, can be of utmost value in diagnosis.

S. R. BEATTY, M.D.

DOSAGE

Roentgen Caustic. G. J. van der Plaats. *Strahlen-therapie*, **62**, 680, 1938.

This is a preliminary report of the author's experience with near distance x-radiation (from 50 to 60 kv., 5 cm. F.S.D., no filter). The great advantage of this technic is the sharp drop of the intensity in the first few centimeters below the lesion. Tables are shown in the paper giving the depth doses for various aluminum filters and focal skin distances. Total doses which are applied according to the fractional method range anywhere from 4 to 16,000 r. A few photographs of patients before and after treatment are reproduced. The paper served as an introduction to a motion picture showing the technic of application and the response to the treatment in a series of cases.

ERNST A. POHLE, M.D., Ph.D.

A Study of Back-scatter. Edith H. Quimby, L. D. Marinelli, and J. H. Farrow. *Am. Jour. Roentgenol. and Rad. Ther.*, **39**, 799-815, May, 1938.

The object of this study was to obtain accurate values for back-scatter over a wide range of qualities of radiation and to investigate the extent of errors involved in making back-scatter determinations with thimble chambers. Accordingly, parallel series of observations were made with the two chambers.

Variation of Back-scatter with Quality of Primary Beam.—When the quality of the radiation is indicated

by its half value layer in copper it is sufficient in defining the back-scatter, for, within the range from 60 to 192 kv., radiation of a definite half value layer gives the same back-scatter regardless of the voltage and filter combination.

Variation of Back-scatter with Irradiated Area.—Up to a certain point, the greater the irradiated area the greater the back-scatter, and the same applies to the hardness of the ray.

Effect of Depth of Underlying Material.—Up to a certain depth the more material there is to scatter, the greater will be the amount of scattered radiation.

No variation of back-scatter with target-skin distance is produced.

There is no great difference between the accuracy of the thimble chamber as compared to the extrapolation chamber, once the percentage of variation is established, except at the extremes of quality in either direction.

Tissue dose cannot be expressed in roentgens, and as suggested by Failla, "tissue roentgens" should be employed. This unit can be determined by the extrapolation chamber.

Charts and tables are shown for every experiment and the entire article should be read.

S. M. ATKINS, M.D.

Dosage Units and the Ionization Method. Rolf M. Sievert. *Acta Radiol.*, **18**, 742-752, October, 1937.

The author discusses the use of ionization measurements in medical radiology and proves that the method, and consequently the international r, can only under certain conditions be considered accurate and suitable for dosage purposes. The chief drawback of the method lies, according to the author, in the fact that it is not proven that the biologic effects of different qualities of radiation are proportional to their ionization values in air. The differences and difficulties encountered in the measurements of the hardest gamma rays and that of ordinary x-ray radiation (100 kv. to 250 kv.) are stressed and a revision of the "International Recommendations for Radiological Units" is advocated.

ERNST A. SCHMIDT, M.D.

The Determination of the Dose in "Rotation" Irradiation. R. du Mesnil de Rochemont. *Strahlentherapie*, **63**, 176, 1938.

In a previous paper (*Strahlentherapie*, **60**, 648, 1937) the author related the fundamental principles of determining the dose if the patient or the tube are rotated during the exposure. In this article he gives a series of dosage curves which permit the calculation of the surface doses and those effective in the tumor very conveniently. His example is based on radiation of a half value layer in copper of 1.2 mm. for rotation at 40 cm. distance.

ERNST A. POHLE, M.D., Ph.D.

FRACTURES

Reduction of Fractures under Roentgenoscopic Control: Two Instructive Examples. H. Tillier. *Bull. et Mém. Soc. de Radiol. Méd. de France*, **26**, 180-182, March, 1938.

The author presents two cases; one of fracture of the lateral condyle of the humerus with interposition of the fragment, the other of fracture of both bones of the forearm. They serve to illustrate his belief that reduction under the screen permits the more rapid and accurate restoration of the fragments to the normal position.

S. R. BEATTY, M.D.

The Base of the Skull, with Particular Reference to Fractures. William J. Mellinger. *Ann. Otol., Rhinol., and Laryngol.*, **47**, 291-305, June, 1938.

A discussion of the anatomy of the base of the skull is given with particular reference to those parts that are most frequently involved by fracture. Fractures usually occur through points and lines of weakness. In the base of the skull these are across and in line with two or more foramina, along the sutures, and through the thin bony plates in the floor of the cranial fossæ. The sphenoid is the "keystone" of the skull and is situated in the line of practically all basal fractures. The floor of the anterior fossa may consist entirely of pneumatized bone, the floor of the middle fossa almost entirely, and the floor of the posterior fossa always consists partially of bone containing air cells. As a result, a basal fracture must usually be considered compound unless proven to be otherwise. Transverse fractures of the petrous pyramid usually extend through the labyrinth and seldom heal by bony union because the endochondral layer is not endowed with regenerative power. In such cases there is constant danger of intracranial involvement in the event of upper respiratory infection. The abducens nerve is very frequently involved in fractures through the middle fossa.

L. W. PAUL, M.D.

Three Cases of Injury to the Cervical Spine, Including One of Unrecognized Fracture of the Odontoid. Brillouet and A. Viel. *Bull. et mém. Soc. de Radiol. Méd. de France*, **26**, 234-237, April, 1938.

Three cases of fracture of the cervical spine are presented with reproductions of the roentgenographs. A case of fracture displacement of the odontoid was remarkable for the paucity of symptoms.

S. R. BEATTY, M.D.

Fracture of the Atlas in Automobile Accidents: The Value of X-ray Views for its Diagnosis. H. F. Plaut. *Jour. Am. Med. Assn.*, **110**, 1892-1894, June 4, 1938.

The x-rays have made it possible to diagnose this injury during life. The atlas has no body proper; instead, the odontoid process of the axis (epistropheus) extends into the anterior part of the atlas ring.

The atlas is injured extremely seldom by direct violence except by projectiles. X-ray examination and

autopsy reveal typical sites for fractures of the atlas: the bilateral and unilateral ones in the posterior arch, where it is weakened by the groove for the artery, and those in the anterior arch. Breaks of the transverse processes and in the lateral masses are the exception.

Vertical pressure on the skull, while the cervical spine is fixed in a straight position, makes the atlas suffer the brunt, and yield, when the lateral masses are squeezed between the occipital condyles and the axis.

The technic for the demonstration of the various types is discussed in detail and illustrated.

CHARLES G. SUTHERLAND, M.D.

HEART AND VASCULAR SYSTEM

Studies of the Circulation in Pericardial Effusion. Harold J. Stewart, Norman F. Crane, and John E. Deitrick. *Am. Heart Jour.*, **16**, 189-197, August, 1938.

The authors, after a study of a patient with pericardial effusion, conclude that the accumulation of fluid in the pericardial cavity of man results in: (1) marked decrease in the volume output of blood from the heart both per minute and per beat; (2) increase in the arm-to-tongue circulation time; (3) rise in venous pressure; (4) increase in intrapericardial pressure; (5) decrease of heart rate, and (6) decrease of vital capacity.

All of these abnormal conditions tend to disappear when excess pericardial fluid is removed. It appears that the decrease of cardiac output is due for the most part to interference with the inflow of blood into the right heart. It cannot be said, however, that contraction is not also impaired. Increase in the amount of pericardial fluid is associated with progressive decrease of cardiac output and rise of venous pressure. Venous pressure falls, rapidly at first and then slowly, to a normal level as fluid is removed from the pericardial cavity.

W. H. GILLENLINE, M.D.

The Significance of Left Auricular Dilatation in Auricular Fibrillation. Marcy L. Sussman and Marston T. Woodruff. *Am. Jour. Roentgenol. and Rad. Ther.*, **40**, 184-188, August, 1938.

The authors studied 96 cases of chronic auricular fibrillation: 44 were classified as cases of rheumatic valvular disease and 52 cases as without rheumatic valvular disease. In the rheumatic heart group all of the patients had definite valvular disease and marked enlargement of the left auricle. In the non-rheumatic group, 22 of the 52 patients were found to have a normal-sized left auricle (seven by postmortem examination).

The roentgen method of study of left auricular size was as follows: the exposures were made in the lateral view while the patient was drinking a barium mixture and taking a deep inspiration at the instant of exposure. The left auricle was considered enlarged when there was posterior displacement of the esophagus.

This method of investigation was not considered an accurate one but the most satisfactory for this study.

The authors' conclusions are as follows:

1. The size of the left auricle was not directly related to the presence of fibrillation.
2. Where the left auricle was enlarged in the non-rheumatic group there was uniformly an accompanying congestive failure.
3. Disproportionate left auricular enlargement in the non-rheumatic group was usually to be accounted for by "mitralization" or by myocardial disease.
4. Dilatation of the left auricle in hyperthyroidism is usually associated with auricular fibrillation and congestive failure.

IRVING I. COWAN, M.D.

The Radiological Examination of the Heart. L. E. Rothstadt. *Med. Jour. Australia*, **2**, 116-122, July 23, 1938.

The author presents three very fine diagnostic representations of the radiological appearance of the heart and describes the appearance of the heart in health and in some diseases. The paper contains an excellent summary of the various physical signs and correlates them with the appearance of the heart.

W. H. GILLENLINE, M.D.

HERNIA, DIAPHRAGMATIC

Diaphragmatic Hernia. E. Mendelssohn Jones. *Minnesota Med.*, **21**, 402-409, June, 1938.

The author reviews the literature on diaphragmatic hernia and its classification. The symptoms resemble those of intestinal obstruction. The condition should be suspected in those patients who have had a crushing injury of the chest, and the importance of fluoroscopic examination in the horizontal and Trendelenburg positions is stressed. The condition should be suspected in cases of dextrocardia.

Five cases are presented. The first followed a bicycle injury in which the patient was thrown against the end of a handle bar. She complained of nausea and vomiting, with gastric distress which was worse always when lying down. Complete relief followed operation. The second patient complained of nausea, vomiting, and heartburn; was very obese, and had a recurrence following operation. The third patient, a woman, 63 years of age, dated her symptoms to whooping cough which she had when a child. She had consulted several physicians, and had had several courses of ulcer management, which aggravated the symptoms each time they were attempted. X-ray examination showed an extensive herniation of the pars cardia of the stomach. She was operated upon and died the second day after operation of multiple pulmonary emboli (autopsy). The fourth patient was a man, 43 years of age, who had been on management for duodenal ulcer for 21 years. X-ray study showed the presence of duodenal ulcer, and operation was done, but the colon was found herniated into the

thoracic cavity through an opening in the right side of the diaphragm four inches in length. Operation gave complete relief of symptoms. Further questioning of the patient brought out the statement that at the age of nine he had fallen from a horse, striking his right side.

It is pointed out in connection with this case that the roentgenologist's attention was so focused on the duodenal bulb during the examination that he did not note the obvious finding of a loop of colon in the thoracic cage.

The fifth patient was a man, 63 years of age, who had had an automobile accident in which three ribs on the left side had been fractured, and in which he had had an injury to his back and side. X-ray examination showed that the entire stomach, all of the jejunum, part of the ileum, and a loop of colon had passed into the left thoracic cage through a rupture in the left hemidiaphragm. Operation was done, with cure of the hernia.

An additional case was presented showing congenital diaphragmatic hernia, in which the left thoracic cavity was crowded with abdominal viscera pushing the heart and lungs to the right thoracic wall. It is readily understood that a hernia of this type is incompatible with life.

The abdominal approach was used in all the cases cited, with ethylene and ether anesthesia. In the case of the large traumatic hernia, administration was by the intratracheal method. The diaphragm was sutured with silk, together with sutures of fascia lata.

In one case of esophageal hiatus hernia the sac was removed, but in the second and third cases the stomach was freed from the hernial sac and the sac allowed to retract into the posterior mediastinum.

In obscure chest cases, thoracentesis should not be attempted until diaphragmatic hernia has been ruled out.

PERCY JOSEPH DELANO, M.D.

HERNIA, HIATAL

Hiatal Hernia. Herman J. Moersch. *Ann. Otol., Rhinol., and Laryngol.*, **47**, 754-767, September, 1938.

A general review of the subject of hiatal hernia is given, based on a series of 246 cases, 64 of which were subjected to operation. Pain situated under the lower end of the sternum or high in the epigastrium is the most frequent symptom. Dysphagia was present in approximately 20 per cent of the cases. Often this was present at the outset of a meal but if the patient could belch or vomit he could then complete the meal without difficulty. Thirty-two cases gave a history of bleeding. The cause of such bleeding is not always apparent. In some a definite ulcer may be found in the hernia, usually at the site where the stomach is in contact with the hernial ring. The diagnosis is dependent primarily on roentgenologic studies but attention is directed to the value of esophagoscopy in the study of this condition. Carcinoma at the cardia may offer a great deal of diffi-

culty in diagnosis roentgenographically and the importance of esophagoscopy to avoid possible unforeseen therapeutic problems is again emphasized. One case is reported in which a foreign body (persimmon skin) became lodged in the esophagus and led to the mistaken diagnosis of tumor. After removal of the foreign body a hiatal hernia of the short esophagus type was demonstrated. The difficulty of differentiating between hernia and normal hiatal relaxation is mentioned.

The problem of treatment is dependent on the type of hernia and severity of the symptoms. The reduction in weight may afford a great deal of relief in the obese patient. Interruption of the left phrenic nerve was carried out in 13 cases with improvement in symptoms in seven. In the remainder the symptoms were aggravated. This procedure is no longer advised as it may lead to post-operative relaxation of the diaphragm with consequent danger of increased difficulty. A number of illustrations showing the various types and roentgenographic features are included.

L. W. PAUL, M.D.

THE HIP JOINT

Acute Arthritis Developing in a Hip Joint Presenting the Lesions of Post-traumatic Coxarthrosis. Lamarque and Bétoulières. *Bull. et mém. Soc. de Radiol. Méd. de France*, **26**, 80-82, January, 1938.

The radiologic evidences of an acute suppurative arthritis are relatively late in making their appearance. These, coupled with the irregularity of contour and density residual from a previous fracture of the neck of the femur, made the radiologic diagnosis difficult in a case of pneumococcus arthritis.

S. R. BEATTY, M.D.

Deformities of the Hip Joint in Children. C. G. Teall. *Proc. Royal Soc. Med.*, **31**, 935-939, June, 1938.

The author discusses roentgenographically those deformities frequently seen in a children's hospital.

The largely cartilaginous state of surrounding bone permits little direct information concerning normal appearance of the condition of the infantile hip. Ossification usually appears in the heads of the femurs in the second six months, but may do so in the first three months, or after the first year. Unilateral delay is not a fully reliable sign of abnormality. Accurately positioned views are required, including both hips on one film, and avoiding external rotation of the femurs.

Congenital dislocation may be unilateral or bilateral, complete or partial. Slight displacement is readily overlooked. Early recognition, though important, is exceptional before the child walks. A shallow sloping acetabulum, which lacks its normal horizontal buttress, is the most important sign before ossification appears in the femoral head. This ossific center may be delayed or small as compared with an opposite normal hip. The shallow acetabulum is further filled with an overgrowth of fibrous tissue and cartilage, leaving a wide joint space after reduction. A false acetabulum,

shallow or well formed, may form on the side of the ilium, in long-standing cases. Displacement may be negligible before weight-bearing, but is revealed by a break in the normal curve from the femoral neck to the pubic ramus. Films after reduction must be studied for fracture as well as for position, especially when reductions are made after a period in plaster. Apparently good reductions may fail because the acetabulum remains abnormal or because the femoral head, injured in reduction, develops poorly. Later the condition may be hard to distinguish from old osteochondritis.

The earliest sign of tuberculosis is a slight local rarefaction of bone, best seen by comparison with the opposite hip. The disease may begin in the synovia and, uncommonly, it may run its course without a recognizable lesion of bone. Usually an evident focus, not long delayed, is seen in the head or neck of the femur, or in the acetabulum. Trabeculae become ill-defined and disappear, first showing mottled rarefaction and later, an area of complete destruction. This process is generally slow but in severe cases part or all of the head and neck of the femur and the adjacent acetabulum may disappear rapidly. The joint is usually involved early, though primary foci in the neck of the femur may remain localized. With improvement, recalcification proceeds till the remaining bone reconsolidates. An almost normal-appearing joint can result only after very early arrest. Complete disorganization nearly always occurs. Sound ankylosis in good position is usually a hoped-for and satisfactory result.

Osteochondritis deformans juvenilis coxa, heralded by a limp, occurs predominantly in the male between the ages of five and ten years. Various supposed causes remain unproved. The epiphysis of the femoral head becomes flattened and dense. Its base then becomes irregular, and cavity-like decreased densities appear in the metaphysis. The epiphysis becomes denser and flatter. The weakened diaphysis broadens and the fragmented epiphysis spreads over it, resulting in gross deformity. The outer margin of the still normal acetabulum deforms the enlarged epiphysis by pressure. The broadened epiphysis consolidates and the acetabulum molds to fit it. Deformity and fair function result after a usual course of four years. Arthritic changes follow.

Acute infective arthritis is commonly secondary to sepsis elsewhere, usually from the streptococcus or pneumococcus, and especially it follows scarlet fever. The roentgenographic evidence varies with the severity. Distention widens the joint and may even cause subluxation or dislocation. Erosion of articular surface and variable destruction of bone occur. The femoral epiphysis may separate and may be destroyed. Complete disorganization and eventual ankylosis are frequent. In the infant, a primary epiphysitis secondarily involves the joint. Subluxation or dislocation are found and the epiphysis is usually completely destroyed. Ankylosis does not follow in the infant as a

rule and the end-result may resemble old congenital dislocation.

Congenital syphilis in the hip is more commonly of the osteochondritic type. The severity varies from a slight rarefaction on either side of the epiphyseal line to a gross destruction. Metaphyseal infraction may cause a so-called epiphyseal separation, as in scurvy.

Coxa vara is produced by weight-bearing on a weakened neck which may reduce its angle from a normal 160 degrees to less than 90 degrees. The origins may be:

Infantile type: a clinical entity, though attributable to causes later described. Its changes are of osteochondritic nature. It is usually bilateral, but without symmetrical degrees of involvement.

General bone disease: as rickets, achondroplasia, dyschondroplasias, particularly that type confined to hips and certain vertebral bodies.

Local disease of bone: as tuberculosis, osteochondritis juvenilis, and osteomyelitis.

Slipping femoral epiphysis: an adolescent type of slip (between the ages of 10 and 15 years) is presumably due to trauma plus osteochondritis. The cause is not fully understood but is not purely trauma. The displacement varies from a slight one to one in which the metaphysis rests upon the acetabulum. The epiphysis appears normal, but the diaphysis may appear abnormal. Early reduction may give good function. Inadequate treatment results in gross deformity, necessitating osteotomy. Epiphyseal slip may follow definite local disease, such as osteomyelitis, septic arthritis, or renal rickets.

Coxa valga may appear in instances in which the femur has not borne weight as in unreduced congenital dislocation, progeria, and fragilitas osseum.

RAY A. CARTER, M.D.

Traumatic Dislocation of the Hip Followed by Perthes' Disease. Raphael R. Goldenberg. *Jour. Bone and Joint Surg.*, 20, 770-774, July, 1938.

Perthes' disease following traumatic dislocation of the hip is demonstrated by a case report. The onset was thirteen months after the dislocation. No evidence of deformity of the femoral head was apparent at the time of dislocation or shortly thereafter. Previous reports of the association are mentioned.

J. B. McANENY M.D.

INFECTION

Radiation Therapy of Fungus Infections. Davis Spangler. *Texas St. Jour. Med.*, 34, 289-291, August, 1938.

Yeasts and fungi are constantly present in the mouth and often on the skin. They usually gain entrance to the body through some wound. The morbid changes are those of chronic suppuration, tissue destruction, and the formation of granulation tissue. No tissue of the body serves as an effective barrier. The diagnosis is usually tumor or abscess.

Persistent and thorough radiation is more effective

than either potassium iodide or surgery. Small lesions are given from 1,000 to 3,000 mg.-hr. of radium. Extensive or deep-seated lesions are given from 1,500 to 3,000 r units of x-ray to the diseased area in daily doses of from 200 to 250 r, repeated each 6 to 12 weeks until all evidence of the infection has disappeared. Several cases are reported.

JOHN M. MILES, M.D.

Radiation Therapy of Infections. Harold G. Reineke. *Jour. Med.*, **19**, 463-465, November, 1938. Reineke diverts attention from the common belief that only malignant conditions are treated with x-rays, and stresses several common infectious processes that respond well to radiation.

The rationale of irradiation is not known but it has been shown that almost immediately following exposure to x-rays the leukocytic infiltration is affected, in that these cells begin to disintegrate. This is followed closely by relief of pain and the beginning of spontaneous resolution. It is believed that the disintegration of the leukocytes liberates protective elements which counteract the effect of the invading organism.

The dosage is moderate in range; the more acute the lesion, the lower the dosage, and the less acute, the higher the dosage. The pathology determines the proper dosage.

Among the infectious processes favorably affected by irradiation are furuncle, carbuncle, abscess, cellulitis, acute adenitis, erysipelas, otitis, mastoiditis, osteomyelitis, and gas bacillus infection.

J. B. McANENY, M.D.

THE INTESTINES

Regional Enteritis. James V. Prouty. *Jour. Iowa St. Med. Soc.*, **28**, 379-382, August, 1938.

Regional enteritis may be encountered in an acute or a chronic form. The lesions are not confined to the terminal ileum but may involve one or more areas of the jejunum, ileum, or colon with the same pathological findings but with varying clinical manifestations. The etiology is unknown. There is no definite clinical picture since the symptoms depend upon the severity, location, and extent of the disease. In acute cases the symptoms are those of an acute abdominal process and the diagnosis of acute appendicitis often is made. In chronic cases, weight loss, secondary anemia, and symptoms of partial intestinal obstruction are prominent. If confined to the colon, the symptoms are those of ulcerative colitis. In early cases the only roentgenological signs may be a persistent irritability and lack of filling of the involved segment with hypomotility of the proximal bowel. Some swelling and flattening of the mucosal pattern may be seen or the mucosa may have a polypoid appearance. Later the wall is thickened and less pliable than normal. If there is ulceration, the walls are jagged and irregular. In advanced cases the lumen becomes narrow and cord-

like. When there is an ileo-colitis the findings are similar to tuberculosis and it is doubtful if differentiation could be made were it not for associated tuberculous lesions elsewhere in the body. When the disease involves only the colon it usually is the proximal portion that is involved. The ultimate prognosis is uncertain and medical treatment has little curative value, treatment being essentially surgical.

L. W. PAUL, M.D.

Problems Presented by Lesions of the Right Quadrant. Otto C. Pickhardt and Henry A. Rafsky. *Jour. Am. Med. Assn.*, **109**, 2048-2053, Dec. 18, 1937.

Every so often patients with a disease condition in the right lower quadrant are encountered who not only have run the gamut of diagnostic procedures for years, but who also have undergone surgical intervention only to have a questionably diseased appendix removed.

In the diagnosis of lesions of the right lower quadrant one must remember that the anatomic relationship of the viscera is such that the symptoms referable to this area may be due to lesions elsewhere in the body and that, conversely, general abdominal complaints or pain in the lumbar and sacral regions may be due to a pathologic process in the right iliac fossa. Lesions of the right lower quadrant are not infrequently associated with other abdominal diseases or systemic infections.

The authors stress the necessity of a careful roentgen study of the small bowel, and report a series of cases in which studies were valuable in the establishment of the diagnosis.

CHARLES G. SUTHERLAND, M.D.

Diagnosis of Chronic Intestinal Amebiasis. Marcel Poirot. *Bull. et mém. Soc. de Radiol. Méd. de France*, **26**, 44-48, January, 1938.

Since the World War the incidence of amebiasis in France has increased and must be suspected in cases with evidence of colitis. There are no diagnostic radiologic findings but there are three characteristic findings: a scalloped appearance of the silhouette of the colon, a ribbon-like appearance, and a rigid tubular colon corresponding to the three chief stages of the disease. Reliance for diagnosis must be placed chiefly in microscopic study of mucus and discharge from the base of the ulcers, which should be obtained before preparation of the colon by enemas.

S. R. BEATTY, M.D.

THE KIDNEYS

A Syndrome Consisting of Affections of the Kidney, Stunted Growth, Rickets, and Disturbed Cystine Metabolism. G. O. E. Lignac. *Am. Jour. Med. Sci.*, **196**, 542-547, October, 1938.

The above-described syndrome has been met with in seven cases and is considered a definite entity. Infantile and juvenile forms are distinguishable. The acute renal changes in this disease separate it from renal rickets. The disturbed cystine metabolism, dis-

coverable only at autopsy, may be due to inability to assimilate this amino acid, with subsequent deposition in, and damage to, the organs, especially the kidneys, or to failure of excretion by the kidneys.

BENJAMIN COPELAN, M.D.

Perirenal Fibrosarcoma. Herbert H. Howard and Howard I. Suby. *Jour. Urol.*, **40**, 491-501, October, 1938.

A case of perirenal fibrosarcoma is reported. A pre-operative diagnosis of a large tumor of the left kidney was made and a large mass was removed through a right rectus incision. High x-ray therapy was started post-operatively, but the patient died in eight months.

The authors recommend immediate extensive x-ray therapy. They are of the opinion that surgery offers nothing in these cases.

JOHN G. MENVILLE, M.D.

Late Results in the Conservative Management of Nephrolithiasis. James T. Priestley and William F. Braasch. *Jour. Am. Med. Assn.*, **109**, 1703-1705, Nov. 20, 1937.

Operation is usually advised and performed if a patient is found to have a renal calculus. For various reasons, however, certain persons who have nephrolithiasis are not treated surgically at the time when the diagnosis is first established. The minute nature of the calculus, the complete absence of symptoms, the presence of serious disease elsewhere in the body, advanced pathologic changes in the urinary tract, and other reasons may apparently render operation unnecessary or undesirable. Some patients who are not operated on progress quite satisfactorily under medical management and no serious symptoms referable to the urinary tract develop. Unfortunately, this is not generally true, as in the majority of cases symptoms of varying severity occur sooner or later and may render subsequent operation imperative, or even jeopardize the patient's life. A follow-up study was made of 177 patients who had nephrolithiasis but were not operated on at the time when the stones were first discovered.

In general it was evident that surgical treatment should be advised for primary calculi unless they were so minute that they might pass spontaneously. The absence of pain or urgent symptoms is no excuse for advising against operation. If the stone is not removed, renal damage is progressive to a greater or less extent in the majority of cases and operation often ultimately becomes imperative. If operation is postponed until this time, the chance for performing a conservative operation and preserving the kidney is certainly reduced. If, for any reason, a given stone is not removed soon after its presence is detected, the importance of careful periodic urologic examination cannot be overestimated. Under close observation of this type it may occasionally be safe to treat certain patients with nephrolithiasis medically. Changes in the size of the stone, the pyelographic observations, renal function, and other important factors

can then be detected early and the proper treatment can be instituted before the kidney has been too severely damaged. Excretory urography will usually supply the pertinent data in such cases.

Although many of the patients who had large, bilateral branched calculi survived some years without evidence of serious difficulty, in almost every case grave symptoms developed sooner or later, and very few of them were living ten years after the stones were first discovered. In some cases small calculi associated with large branched stones became dislodged and occluded the ureter. Damage to the renal parenchyma was progressive, so that ultimately the renal reserve was greatly depleted and operation or any intercurrent demand on renal function carried a very high risk. Destruction of the kidneys was often slow and during the ensuing years the patient may have enjoyed comparative comfort while resting under a sense of false security.

With the current improvements in surgical procedures and post-operative treatment the risk of operation in cases of this type has been definitely reduced and the chance of preserving a functioning kidney correspondingly enhanced. Obviously, if operation is to be performed, the optimal time is prior to the development of renal insufficiency.

CHARLES G. SUTHERLAND, M.D.

Roentgenologic Demonstration of a Papilloma of the Kidney Pelvis. Hans Keilhack. *Röntgenpraxis*, **10**, 669-671, October, 1938.

Primary tumors of the kidney pelvis are rather uncommon. Their roentgenologic demonstration is based on irregular contours in the filling of the kidney pelvis by contrast material or by an eccentric dilatation of the kidney pelvis.

The author describes a case of a benign papilloma of the kidney pelvis, demonstrated by a retrograde pyelogram and proved by autopsy. The right kidney pelvis was markedly dilated and there was an intrinsic smooth filling defect the size of a walnut. Because of the death of the patient from a brain hemorrhage it was thought to be a malignant tumor with brain metastases, but autopsy showed it to be a benign papilloma.

HANS W. HEFKE, M.D.

KYMOGRAPHY

Roentgen Kymographic Studies of Aneurysms and Mediastinal Tumors. Wendell G. Scott and Sherwood Moore. *Am. Jour. Roentgenol. and Rad. Ther.*, **40**, 165-172, August, 1938.

The history of roentgen kymography is briefly summarized and a description of the kymograph is given.

The authors state that since the film is a graphic record of physiological movements of the heart and great vessels, kymography is applicable in differentiating between aneurysms and intrathoracic tumors. Aneurysms, ordinarily, produce movements over their borders while tumors do not.

By the use of the kymograph a differentiation is made between expansile and transmitted pulsations. If the movement is expansile, both sides of an aneurysm will move outward from the mass at the same moment, and medially at the same time. The diameter of the mass increases at systole and shortens at diastole. This finding strongly supports the diagnosis of aneurysm. If the movement is transmitted, both borders of the mass shift in the same direction at the same time, and the diameter of the mass remains constant. Diagrams of these movements are shown. For such a study, it is necessary to place the kymograph so that both sides of the tumor are recorded through the same slit. The change in density of a mass during systole and diastole is another aid in differentiating between aneurysm and neoplasm. Kymographs also possess a Potter-Bucky grid effect which permits better visualization of the course of the thoracic aorta with respect to adjacent masses.

The limitations of this method of examination are stated, and illustrative cases are cited. The authors conclude that the method is a valuable one but cannot be employed successfully in all cases because: (1) large, thick-walled aneurysms with laminated blood clots may not record motion; (2) tumors in close apposition to the heart and great vessels may show transmitted movement at their borders, and (3) an extremely vascular tumor may show expansile motion, although this is rare.

IRVING I. COWAN, M.D.

THE LUNGS

Pulmonary Pneumocyst: Report of an Enormous Solitary Cyst in a Healthy Adult Female. Garnett Cheney and L. Henry Garland. *Am. Jour. Med. Sci.*, 196, 699-703, November, 1938.

A case of a giant pulmonary cyst displacing the heart and mediastinum to the opposite side is reported. An abnormal condition of the involved lung was discovered by x-ray examination 17 years previously. Despite a vital capacity only 27 per cent of the expected normal, the patient suffered no complaints, even after violent exercise.

BENJAMIN COPLEMAN, M.D.

Massive Atelectasis Following Cyclopropane Anesthesia: Report of Cases and a Theory of Cause and Prevention. Oswald R. Jones and George E. Burford. *Jour. Am. Med. Assn.*, 110, 1092-1095, April 2, 1938.

This is a report of cases and a theory of cause and prevention. Autopsy, when preformed in cases coming to the authors' attention, showed massive atelectasis of one or both lungs.

The circumstance producing complete atelectasis of a whole lobe has of recent years been assumed to be obstruction in the main bronchus followed by absorption of the alveolar gases behind the obstruction. When the obstruction becomes effective, the time required for development of atelectasis depends on the rate of absorption by the lung of the gases distal to the obstruc-

tion, provided the circulation in the lung is intact and the alveolar epithelium undamaged.

It was shown that great variation exists in the rate of this absorption. Anesthetic gases were absorbed in a matter of minutes, the inert gases nitrogen, hydrogen, and helium required from 18 to 26 hours for absorption, which even then, for helium, was not complete. Reviewing the time required for a comparable degree of absorption of 600 c.c. of gas by the lungs of dogs, the great rapidity of absorption of the anesthetic and active gases as compared with the inert "filler" gases was emphasized. It was observed under direct vision, after blocking the bronchus, that a specific degree of atelectasis appeared after the varying intervals stated for the different gases. Toward the end of an operation the patient may be breathing an atmosphere made up almost entirely of rapidly absorbable gases, the inert gases having been lost during the anesthesia. When the alveoli of the lungs have lost the supporting properties of the inert gas nitrogen, conditions are present which favor atelectasis. Patches of atelectasis may develop without an obstruction in any portion of the bronchial tree; this creeping atelectasis could go on until an entire lobe was involved. The first indication of it would appear when the mask was removed at the end of the operation.

The obvious remedy is to add inert gas to the cyclopropane mixture.

The most useful addition to the cyclopropane atmosphere or other anesthetic atmospheres should be either hydrogen or helium, the latter—being light and inert and not explosive—seems at this time to be the best substitute for nitrogen in the replacement of that very necessary supporting gas in the pulmonary alveoli.

CHARLES G. SUTHERLAND, M.D.

The Value of Radiology in the Elucidation of Hemoptysis. Franklin G. Wood. *British Med. Jour.*, 2, 211-213, July 30, 1938.

The author opens his article with a statement that hemoptysis may be a symptom of any acute lung disease. Roentgenographs should be made in all cases in which tuberculosis is suspected. Oblique and lateral positions as well as the usual post-anterior and anteroposterior should be made. Non-tuberculous conditions are discussed as follows:

Bronchiectasis.—In cases in which it is suspected, lipiodol should be used to demonstrate cavities. The oral method of injection is best.

Heart Disease.—Hemoptysis is an important symptom in mitral stenosis. Roentgenography is a great help as it shows typical heart outline and lung congestion. Kymography is proving to be of considerable use.

Bronchial Carcinoma.—Frank hemoptysis is uncommon but lung changes can be seen in the roentgenograph.

Aneurysm of Aorta.—Differential diagnosis from growth or tumor must be made, although it is sometimes difficult. The kymograph is of great assistance here.

Hemoptysis sometimes follows chest trauma even when no rib fracture can be demonstrated. It is well known that no examination of the chest is considered complete to-day without thorough roentgenographic investigation.

Q. B. CORAY, M.D.

Radiation Therapy in Primary Neoplasms of the Lung. Ralph E. Myers. *South. Med. Jour.*, **31**, 275-286, May, 1938.

Six cases are reported, one of which, microscopically proved carcinoma, is living and well five years after the first course of roentgen therapy. Intensive radiation was used.

Radiation changes in the lung may render it a weak spot and so lower its resistance as to make it especially susceptible to infection. In two heavily irradiated patients, abscesses formed in the irradiated portion of the lung.

JOHN M. MILES, M.D.

Acute and Chronic Atelectases of the Lungs and Their Sequences. Rudolf Pohl. *Röntgenpraxis*, **10**, 651-659, October, 1938.

If the alveoli of one part of the lung are without air and there is no evidence of inflammatory changes, one calls these findings an atelectasis. An occlusion or a narrowing of the bronchus supplying a certain area is of greatest importance for the occurrence of an atelectasis, for instance: swelling of the mucosa, secretion, blood clots, glands, tumors, foreign bodies, etc. But there are other types of atelectasis in which a bronchial obstruction cannot be found, the so-called idiopathic or dynamic atelectasis. Roentgen studies of the lungs have added much to the diagnosis of atelectasis.

The author describes in detail seven cases which were proved either by their course or by autopsy.

Enlarged hilar glands, often tuberculous, may cause an acute atelectasis which disappears completely in a relatively short time, sometimes in 24 hours. This type of atelectasis is most often seen in children.

Two cases are described in which such bronchial occlusion took place in adults, both on the basis of tuberculosis of the hilar glands. In one case bronchioliths, probably arising from calcified glands, led to attacks of bronchial obstruction and atelectasis relieved the obstruction by coughing up the calcified material.

If the process which causes the atelectasis persists for a certain time the involved lung exhibits evidence of a chronic atelectasis. That portion of the lung is shrunk and the lung tissue shows signs of chronic induration with secondary inflammatory changes, bronchiectases, and central abscesses. Mediastinitis and pleuritic involvement often accompany this type.

The chronic atelectasis is seen in a typical fashion in the bronchogenic carcinomas. Such cases are described herein. Hodgkin's disease, aneurysm, gumma, and other lesions may lead to an atelectasis.

A case of a dermoid cyst of the lung is quoted. The diagnosis was obscure for many years, because the

cyst was hidden by the chronic atelectasis. A bronchogram made the diagnosis and surgery proved it.

In all cases of atelectasis of the lungs not only must the correct diagnosis be made, but an effort must be made to find the etiologic factor causing the atelectasis.

HANS W. HEFKE, M.D.

Primary Carcinoma of the Lung: A Clinical Study of 160 Cases in Five Years. Aaron Arkin. *Jour. Kans. Med. Soc.*, **39**, 369-372, September, 1938.

During the past five years the author has seen 160 cases of primary cancer of the lung. He is convinced that this is one of the most frequent chronic pulmonary diseases in persons past 40 years of age. It must always be considered in cases of lung atelectasis, abscess, recurrent pneumonia, hemorrhagic pleurisy, empyema, or chronic pneumonia. Pain in the chest or other parts of the body, a cough and bloody expectoration, and sooner or later dyspnea, and loss of weight are the cardinal symptoms. However, it is pointed out that the symptoms are extremely variable and in about 50 per cent of the author's cases the signs and symptoms were predominately outside the lungs and due to metastases. Secondary involvement of the osseous system was present in 14 per cent of the cases and this formed the largest group with extra-pulmonary symptoms. After this, in the order of frequency, were cerebral, 10 per cent; cardiac, 8 per cent; gastrointestinal, 8 per cent; lymphoglandular, 6 per cent, and hepatic, 3 per cent. The use of roentgen rays in diagnosis is stressed.

L. W. PAUL, M.D.

The Necessity for Repeated Roentgen Investigation in Late Manifestations of Tuberculous Bronchogenic Dissemination. H. Bartsch and S. Zollner. *München. med. Wchnschr.*, **85**, 1078-1080, July 15, 1938.

An obscure case, having as its basis the late manifestations of a tuberculous bronchogenic dissemination, is reported to illustrate the need for repeated roentgenograms to clear up the diagnosis.

LEWIS G. JACOBS, M.D.

The Roentgen Image of Encapsulated Left Diaphragmatic Pleurisy. H. Morr. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, **58**, 66-76, 1938.

In criticism of a paper on this subject by L. Daniello (previously published in the same journal, **56**, 541-584, October, 1937), the author postulates for the diagnosis of encapsulated exudative diaphragmatic pleurisy:

1. Band-like shadows superseding the diaphragm and able to be differentiated from the latter and from subphrenic accumulations of gas.

2. It must be shown by serial examinations that the shadow, assumed to represent such exudate, diminishes continually during aspiration and is replaceable by air—under identical technical conditions of exposure, of course.

3. Relationship of the band-like shadows to a

symptomatology excluding all other possibilities of differential diagnosis.

The paper is of value especially as it illustrates and analyzes the appearance and varying thickness of the normal left diaphragm plus the wall of the gastric fundus, with varying degrees of inflation of the stomach. It follows a reply by Daniello citing a case of right-sided encapsulated diaphragmatic pleurisy demonstrated at autopsy, and there are final remarks by Morr.

H. A. JARRE, M.D.

The Significance of Calcifications within the Lungs. D. A. Rhinehart. *South. Med. Jour.*, **31**, 339-345, April, 1938.

In the lungs, calcification is always in healed, healing, or encapsulated tuberculous processes. It occurs only after necrosis of tissue followed by encapsulation.

Most commonly it is found following the initial infection in the so-called "childhood tuberculosis," consisting in one or more nodules in the lung parenchyma and corresponding calcified hilar nodes. Multiple calcified nodules scattered throughout the lungs with calcified hilar glands probably represent a healed tuberculous bronchopneumonia.

In the re-infection, or adult type of tuberculosis, calcification may be found but is not so common as in primary infections because fibrosis rather than calcification is the rule when healing occurs.

Bilateral symmetrical calcifications indicate a healed hematogenous pulmonary tuberculosis and may be so numerous and disseminated as to indicate a miliary tuberculosis of the lungs with recovery.

A case report of the latter type is included with roentgenograms made over a ten-year period in a white female adult showing the transition from the acute to the completely calcified stage.

JOHN M. MILES, M.D.

Pulmonary Asbestosis. IV.—The Asbestos Body and Similar Objects in the Lung. Kenneth M. Lynch. *Jour. Am. Med. Assn.*, **109**, 1974-1978, Dec. 11, 1937.

One of the conspicuous and interesting features of the pulmonary condition resulting from the inhalation of asbestos dust by miners and mill workers in this material, is the occurrence of certain curious bodies in the lungs and peribronchial lymph nodes and frequently in the sputum. They measure from about ten to more than 100 microns in length and from about one to 12 microns in thickness, and are composed of a central translucent fiber or needle crystal, the asbestos crystal, with an enveloping shiny golden or brownish substance constructing various architectural figures. The whole object may be a rod with smooth blunt ends or, more often, with one or both extremities in a single rounded knob or a clump of such knobs, reminding one of the fruit body of *Aspergillus*. Frequently the shaft is a series of rounded beads or disks strung closely along the central filament. Again the object may be of the shape of a club, often with one knobbed end, or it may be a long slender filament. Spherical forms of various

sizes are also seen. Characteristically these bodies give a Prussian blue reaction for iron. The hypothesis was advanced that the asbestos body is a particle of asbestos fiber in the process of alteration and absorption by hydrolysis, with the silica passing into a colloidal state and a gel.

These bodies may be found in the lungs of asbestos workers, within the bronchioles, the alveoli near about, and the interlobular, peribronchial, and subpleural tissues along the lymphatic route. They occur also in peribronchial lymph nodes, within sinus walls, and embedded in fibrosed areas. Here they are usually of the shorter lengths although some may be surprisingly long considering their route of collection through small lymphatic channels. Characteristically, they are limited to the bronchial tract, the adjacent pulmonary alveoli, the peribronchial connective tissues, and the peribronchial lymph nodes. They have been seen within veins in the lungs and have been found embedded in the splenic pulp.

The presence of this material in abundance and over a long period does not necessarily result in fibrosis or other apparent damage to the tissue. Often, however, the asbestos bodies not only incite phagocytosis while within bronchioles and particularly alveoli, but enter the tissues and apparently the lymphatics and lodge along the course, tending to stimulate growth of fibrous tissue about them. Thus fibrosis of the course of lymphatic circulation in the lungs and peribronchial lymph nodes is the resulting disease. The disease is a diffuse type of fibrosis rather than the nodular form of silicosis proper.

Asbestos bodies may be found in the sputum of workers whose exposure to the dust was not material and who exhibited no evidence of pulmonary abnormality.

CHARLES G. SUTHERLAND, M.D.

THE NOSE

One Hundred Broken Noses. J. W. Gerrie. *Canadian Med. Assn. Jour.*, **39**, 433-436, November, 1938.

Practically all nasal fractures are impacted and, broadly speaking, of two types. (1) The lateral impaction fracture is by far the more common and occurred in 85 of the author's 100 cases. The blow is received on the side of the nose, either because it is directed from that angle or because the recipient has had time to turn the head reflexly away from the oncoming blow. (2) The vertical impaction, or depressed type, is usually the result of a terrific smash without warning from a head-on direction. The nose is "bashed" in, and the bones fragmented and impacted in a variety of positions. Soft tissue and bony damage is severe. Swelling appears quickly and masks the underlying bone damage. The history and a glance usually suffice to diagnose the lateral impaction type. The depressed type is more difficult to diagnose, as swelling quickly precludes palpation. The patient's story that the nose was "pushed right in" may be a true description. Both types are usually compounded

internally and severe nasal bleeding may be considered evidence of a fracture.

Roentgenograms help to assess the extent of the damage and complete the diagnosis. The routine procedure of the author is to take a lateral film and an occlusal film. Repositioning of the fragments becomes increasingly difficult and less certain as time elapses, and so, regardless of swelling or lacerations, is done as soon after the injury as is expedient.

M. L. CONNELLY, M.D.

THE PANCREAS

A Characteristic Duodenal Deformity in Cases of Different Kinds of Peri-vaterial Enlargement of the Pancreas. Nils Frostberg. *Acta Radiol.*, **19**, 164-173, May, 1938.

Frostberg describes three cases of duodenal deformity which occurred in the descending portion of the duodenum, assuming the shape of an inverted figure "3." The roentgenogram suggested newgrowths involving the head of the pancreas as the most plausible explanation. The autopsy findings showed that, in addition to pancreatic tumors, pancreatitis and edema may be responsible for the deformity.

ERNST A. SCHMIDT, M.D.

The Roentgen Diagnosis of Diseases of the Pancreas. Rudolf Pohl. *Röntgenpraxis*, **10**, 659-667, October, 1938.

Our diagnostic methods are comparatively meager when we apply the roentgen rays to the diagnosis of diseases of the pancreas. The normal pancreas is not demonstrable by roentgen methods.

Direct roentgen signs can be detected only when there are concretions in the pancreas or gas-containing cavities. Most of the roentgen symptoms are indirect: changes in the normal shape or function of stomach and duodenum, gall bladder, colon, and diaphragm.

In pancreatitis or pancreatic necrosis the following roentgenologic signs have been described: gas dilatation of stomach and transverse colon, atony of the duodenum, and compression of the descending port on of the duodenum by an inflammatory tumor in the head of the pancreas. The lungs may show inflammatory or atelectatic changes in the bases, especially on the right side. In chronic cases, adhesions to the stomach, particularly the antrum and the lesser curvature, may be demonstrable. A case report illustrates these signs.

When complications take place, peri-pancreatic abscesses with fluid levels might be demonstrable. A case with a left-sided subdiaphragmatic abscess following a pancreatic abscess is quoted by the author.

The so-called pancreatic cysts have been an object of roentgenologic study to a considerable extent for some time. These cysts are really not tumors, but usually of inflammatory nature. They are in many cases the sequence of a pancreatic necrosis. Most of them are pseudo-cysts in the omental bursa. Their roentgenologic demonstration depends on their size and

the displacement of neighboring organs. Often they are demonstrable on flat films of the abdomen. The barium-filled stomach is usually displaced toward the left, and shows a smooth extrinsic filling defect on the lesser curvature with preservation of the normal mucosal pattern. Occasionally these pseudo-cysts are found lying between the stomach and the transverse colon and displace the stomach as well as the colon.

A case is described in which a large metastasis in the left lobe of the liver led to the erroneous roentgen diagnosis of a pancreatic cyst.

Carcinoma of the pancreas is most often seen in the head of the pancreas. The x-ray diagnosis is based on the C-like displacement of the duodenal loop, extrinsic pressure on the lesser curvature of the stomach, and displacement of the antral portion. At times an increase in the distance between the antrum of the stomach and the spine may be demonstrated on lateral films. After a cancer reaches a certain size it may infiltrate the stomach and duodenum (rigidity of their walls, absence of peristalsis, and changes in their mucosa). By quoting a case, it is shown that the differential diagnosis between a primary cancer of the stomach and cancer of the pancreas, secondarily invading the stomach, might at times be very difficult or impossible.

Pancreatic stones, mostly consisting of calcium carbonate or phosphate, are seen at the level of the first or second lumbar vertebrae overlying the spine in a transverse fashion. They are often secondary to infection, abscesses, or even cancers.

HANS W. HEFKE, M.D.

PEPTIC ULCER

Late Results of Surgical Treatment in Perforated Peptic Ulcer. J. Verney Cable. *British Med. Jour.*, **2**, 403, 404, Aug. 20, 1938.

In this rather concise article the author presents a series of statistics on the subject based on 41 cases of peptic ulcer treated surgically and 81 cases of the same condition treated medically. The percentages of duodenal and gastric lesions are comparable in each series; the conclusions in the case of surgery being based on the surviving patients, which number 29.

Data regarding condition of the patients some time after treatment are tabulated under headings of excellent, good, fair, and poor. There is a rather close similarity apparent, and the conclusions made oppose the well-known theory that perforated ulcers are symptom-free after surgical closure. One is inclined to the impression, from this article, that surgery of the stomach as well as of the duodenum is in the main an emergency measure.

Q. B. CORAY, M.D.

The Limitations of Internal Medical Treatment of Gastric and Duodenal Ulcers. Heinrich Müller. *München. med. Wchnschr.*, **85**, 1195-1199, Aug. 5, 1938.

The article deals chiefly with the treatment of ulcer, but affords some interest to the radiologist in its at-

tempt to correlate the roentgen appearance with the acceptable treatment. Perforation and pyloric stenosis are absolute indications for surgery, and produce typical films. Suspicion of malignant change, as manifested by enlargement of the crater under treatment, is also a surgical indication. Failure of a benign ulcer to decrease under therapy should in any case lead one to consider surgery. The mere existence of marked roentgenological alterations should not, however, be made the sole grounds for surgical intervention. Among the conditions which offer a challenge to operative intervention are the hour-glass stomach, outspoken delay in emptying, high grade involvement of the lesser curvature, leather-bottle stomach, and advanced scarring of the cap. Bleeding is often an indication for surgery. Evaluation of symptoms and social status is often important. Surgical contra-indications are noted. The article is well illustrated.

LEWIS G. JACOBS, M.D.

PNEUMONIA

Resolving Lobar Pneumonia in Adults Simulating Tuberculosis in the Roentgenogram. Samuel Cohen. *Am. Jour. Roentgenol. and Rad. Ther.*, **40**, 202-214, August, 1938.

The author reviews 10 cases of resolving pneumonia in adults who were erroneously suspected of having tuberculosis. Five of the cases were presented with serial roentgenographic studies. He emphasizes the value of serial roentgenograms taken at short intervals. In addition, the history and entire clinical course should be studied, including repeated sputum examinations and tuberculin tests.

From a roentgenologic standpoint the differentiation between resolving lobar pneumonia and tuberculosis is based on two factors: (1) the time interval for resolution of the pulmonary process (in lobar pneumonia the clearing of the infiltration is comparatively rapid, while the slow rate of resolution of tuberculous lesions is characteristic), and (2) the absence of a residue of the pulmonary infection as resolution is completed. The latter is more characteristic of lobar pneumonia. Cases of delayed resolution in lobar pneumonia, particularly when present in the upper lobe, are more difficult to differentiate roentgenologically. All factors which may retard the healing of a pneumonic process should be considered.

IRVING I. COWAN, M.D.

Delayed Resolution in Bronchopneumonia. F. N. Cole. *Jour. Iowa St. Med. Soc.*, **28**, 389-392, August, 1938.

Delayed resolution in bronchopneumonia is not a clear-cut clinical entity and some do not believe that such a condition exists. The author is of the opinion that it is largely a matter of definition. The diagnosis is based on the following points: (1) A history of a preceding bronchopneumonia. (2) Persistence of symptoms after the acute condition has passed. (3)

Physical findings of consolidation. (4) X-ray evidence of increased density in the lung. (5) Exclusion of other known conditions.

The differential diagnosis includes: (1) tuberculosis; (2) empyema; (3) pleurisy with effusion; (4) lung abscess; (5) malignancy of the lung; (6) spontaneous pneumothorax; (7) bronchiectasis; (8) fungus infections; (9) syphilis; (10) foreign body; (11) Reismans' pneumonia; (12) lipoid pneumonia in infants, and (13) atelectasis due to plugging of a bronchus or bronchiole by exudate or swelling. The author believes that this latter condition is probably what is present in most of the cases which do not fall into any of the above categories.

Bronchoscopic examination with the removal of any obstructing material will effect a cure. The prognosis usually is good except in the very old or very young.

L. W. PAUL, M.D.

Tuberculous Pneumonia. J. W. Strayer. *Jour. Indiana St. Med. Assn.*, **31**, 605-608, Nov. 1, 1938.

The deposition of a large number of tubercle bacilli in high concentration on allergic tissue forms the pathogenesis of this condition. In the lobar type the lesion is usually in an upper lobe and massive caseation appears in from one to two weeks; cavity formation usually takes place early.

In the acute bronchopneumonic form the disease may be limited to a few lobules or may involve both lungs. It closely resembles non-tuberculous pneumonia until caseation occurs. Large soft tracheo-bronchial nodes are a constant finding and their rupture may be the cause of the dissemination.

The clinical course resembles non-tuberculous pneumonia except that resolution does not take place as expected, but is prolonged.

The x-ray film usually shows an upper lobe involved and occasionally a cavity. Pleural thickening at the periphery or at the interlobar fissure usually speaks for tuberculosis. The prognosis depends upon the extent of the disease, the resistance of the patient, and his proper care. The course is long. Several excellent roentgenographs are presented.

J. B. McANENY, M.D.

Roentgen Therapy of Lobar Pneumonia. Eugene V. Powell. *Jour. Am. Med. Assn.*, **110**, 19-22, Jan. 1, 1938.

The author reports the results of roentgen radiation in 104 cases of acute lobar pneumonia and in 30 cases of bronchopneumonia.

It was soon noted that patients who had received roentgen therapy were generally relieved of much of their respiratory and circulatory distress, occasionally within 30 minutes, but more often within two to three hours.

The technic is 250 to 350 roentgens of 0.3 Ångstrom unit of effective radiation (135 kv. with 3 mm. alumi-

num filter) given anteriorly or posteriorly over an area a little larger than the involved portion of the lung. If the temperature and white blood cell count have not dropped to normal within 36 to 48 hours, a second roentgen treatment is given to an opposite field. It is only when the leukocyte count remains high, or when temperature remains elevated, that the additional treatment is given. A few patients with pneumonia of mixed infection received a third or fourth treatment.

Bronchopneumonia seemed to be more variable and as a whole less favorably influenced than lobar pneumonia. Patients with bronchopneumonia, treated during the first three or four days with diathermy and then given roentgen therapy, responded well, in the experience of others.

The author found that patients with lobar pneumonia treated with roentgen rays during the stage of congestion recovered more slowly.

Patients with a mixed infection frequently showed a prompt response followed by a secondary rise in temperature a few days later. After a second or third roentgen treatment these patients generally returned to normal and remained normal.

CHARLES G. SUTHERLAND, M.D.

RADIUM

How is Soluble Radium, Injected into an Animal, Distributed in the Various Body Tissues? F. Daels, H. Fajerman, and van de Putte Van Hove. *Strahlentherapie*, **63**, 545, 1938.

The authors injected normal mice, normal white rats, and guinea pigs, including pregnant animals and also some with a sarcoma, with soluble radium solutions containing up to 0.06 mg. element. To determine the radium content of the various dried or embedded tissues, the film method was used. The exposure time varied from one week to three months. Most of the radium was found in the liver, kidneys, lungs, and bone marrow. Placenta and embryo also contained radium. Sarcomatous tissue did not retain radium in a higher degree while muscles and brain tissue contained hardly any radium.

ERNST A. POHLE, M.D., Ph.D.

The Experimental Production of Sarcoma with Radium and Mesothorium. E. Uehlinger and O. Schürch. *Schweiz. med. Wchnschr.*, **68**, 860, 861, July 16, 1938.

The authors found that by placing a mixture of either mesothorium or radium (0.002-0.005 mg.) and vaseline (0.2 g.) in the marrow cavity of the femur of rabbits, they could produce sarcomas, either of the osseous or marrow structures, in from 57 to 63 per cent of the animals. The tumors were entirely similar to spontaneous human tumors. There was a latent period of 18 months or more in which no case of carcinoma was produced. Analogous doses of radium and mesothorium produced similar results, and since the two differ in the presence of alpha rays in radium

radiation and their absence in mesothorium radiation, the conclusion is drawn that the carcinogenic rays are the beta rays—not the alpha rays as thought by Martland.

Brief mention is made of the case of a 48-year-old man who was treated from 14 to 18 years previously with heavy doses of radium and x-ray to the sella turcica for an eosinophil adenoma of the hypophysis with acromegalic symptoms, and who came to them with a sarcoma of the ethmoid bone. The possibility of a relationship between the treatment and the tumor is noted, and the danger of such late reactions to irradiation is pointed out.

LEWIS G. JACOBS, M.D.

Radium Therapy of Carcinoma of the Skin and Lip. J. Körbler. *Strahlentherapie*, **62**, 507, 1938.

The author relates his experiences with radium in the treatment of skin and lip cancer. For very superficial tumors he used contact applicators while others are treated at a distance of 1 cm. If the lesion is not too close to the bone, he prefers the implantation of radium needles. The time of application varies from 72 to 120 hours, while the amount of radium is determined by the size of the lesion. The results are compiled in four tables, reviewing the material after a three- and a five-year observation period, respectively. They include all stages of the disease. Out of a total of 357 cases, 26 could not be traced, 51 died from carcinoma, 20 from other causes, 20 developed recurrence, and 240 were well at the end of three years. The number of survivals out of 127 cases observed for five years was 63. Out of 148 lip cases followed for three years, 81 were well at the end of that period, three could not be traced, 52 had died from the cancer, nine from other causes, and three had a recurrence. Of 53 patients who could be followed for five years, 21 remained well at the end of that period. In carcinoma of the lower lip removal of the cervical lymph glands is advised.

ERNST A. POHLE, M.D., Ph.D.

The Significance of Primary and Secondary Beta Rays in Radium Therapy. W. Minder. *Strahlentherapie*, **62**, 601, 1938.

Since all radium preparations send out beta and gamma rays the author investigated their proportion for various filtrations by mathematical and experimental methods. Both primary and secondary beta rays of a radium applicator can be neglected if the radium does not come in contact with the tissue; in other words, if an absorbing layer of from 0.5 to 1.0 cm. thickness (specific gravity = 1) is interposed. If, however, for instance, a radon seed with a wall filter of 0.1 mm. Pt is inserted into tissue, the effect of the primary beta rays is from four to six times that of the gamma rays. The drop of this effect with increasing distance from the source of the radiation is great. For higher filters as, for instance, 0.5 and 1.0 mm. Pt the effect of the radium applicator on the sur-

face is increased due to secondary beta rays by 128 per cent for 0.5 mm. Pt and by 90 per cent for 1.0 mm. Pt. The author also points out that this has to be considered when using the photographic method of Holthusen for the calibration of radium preparations. The films used for the dosage measurements must never be exposed to the secondary beta rays of the filter because this might lead to errors of 100 per cent.

ERNST A. POHLE, M.D., Ph.D.

ROENTGEN-RAY THERAPY

The Scope of Radiotherapy. H. H. Navid. South African Med. Jour., 12, 321-323, May 14, 1938.

The author evaluates the therapeutic possibilities and results of radium and x-ray therapy in carcinoma of the cervix, the breast, and the prostate; in lymphadenoma, leukemia, and in metastatic tumor invasion. Only radiologists with adequate equipment and experience should attempt to do radiotherapy.

ERNST A. SCHMIDT, M.D.

The Technic of Roentgen Therapy of Curved Surfaces. A. Proppe. Strahlentherapie, 62, 109, 1938.

This is a mathematical study of the problem of irradiating curved and irregular surfaces. Several graphs shown in the article permit the calculation of the proper F. S. D., at the same time avoiding the overlapping of neighboring fields.

ERNST A. POHLE, M.D., Ph.D.

Radiation Therapy in Gynecology. Subodh Mitra. Jour. Indian Med. Assn., 7, 404-407, April, 1938.

The author discusses the application of radiotherapy in the more common gynecologic conditions and stresses the desirability of radiologic training for the gynecologist and of gynecologic experience for the radiologist.

ERNST A. SCHMIDT, M.D.

SILICOSIS

Roentgenographic Studies of the Excretion of Dusts from the Lungs. A. E. Barclay, K. J. Franklin, and R. G. Macbeth. Am. Jour. Roentgenol. and Rad. Ther., 39, 673-686, May, 1938.

Insufflation of various dusts of the opaque variety into the lungs of cats failed to reach the alveoli and the dust was excreted from within a few hours to three days. When the same dusts were suspended in liquids the alveoli were reached and massive collapse resulted and progressed even after most of the initiating agent was excreted. The ciliated epithelium appears to be able to arrest dry but not liquid dust.

S. M. ATKINS, M.D.

A Study of Silicosis. Philip B. Matz. Am. Jour. Med. Sci., 196, 548-559, October, 1938.

Persons engaged in dusty occupations, in which

there is a silicotic hazard, in the manufacturing and mechanical industries alone, number 1,200,000. The seriousness of silicosis, which now constitutes the greatest single industrial hazard, is due to the fact that tuberculosis is a very frequent complication.

In a group of 167 silicotic veterans, the majority acquired the disease before the age of 40. The extrinsic factors, such as the type of silica dust, its concentration, length of exposure, and certain intrinsic factors, such as the rate of nodule formation and the presence of pre-existing tuberculous or non-tuberculous infection, which alter the prognosis markedly, influence the duration of the disease.

The cases were divided, according to Sampson's classification, into first, second, and third degree silicosis. The classification depended on the following: the size of the nodules; conglomerate silicosis; silicosis with tuberculosis, in which the two diseases exist as more or less separate entities; silico-tuberculosis, in which one disease cannot be separated from the other, and asbestosis. Over half of these cases showed evidence of tuberculous infection, most of which were classified as being moderately or far advanced.

Cardiovascular disease was the next most frequent complication. The changes were those of progressive dilatation and hypertrophy, secondary to obstruction of the lesser circulation.

Other complicating infections, such as pneumonia, bronchiectasis, and lung abscess were frequently found. Chronic pleurisy was usually found to be due to a complicating infection.

BENJAMIN COLEMAN, M.D.

THE SINUSES

Pneumatization of the Facial Bones in Crouzon's Disease, Apert's Disease, and Oxycephaly. P. de Gunten. Schweiz. med. Wchnschr., 68, 268-270, March 12, 1938.

Thirteen cases of congenital dysostosis of the skull were studied to determine the development of the accessory nasal sinus. Crouzon's disease, characterized by craniofacial dysostosis and exophthalmos, Apert's disease, characterized by craniofacial dysostosis and syndactylia, and oxycephaly were the diagnoses. The author finds no changes in the development of the sphenoid, ethmoid, or maxillary sinus. The frontals are very variable and often absent. There is no evidence that there is any change in development of the sinus due to the osseous dystrophy, and conversely there is no diagnostic value in studies of the sinus to differentiate the type of dystrophy.

L. G. JACOBS, M.D.

Osteoma of the Maxillary Sinus. A. G. Rawlins. Ann. Otol., Rhinol., and Laryngol., 47, 735-753, September, 1938.

Osteoma of the maxillary sinus is a very rare tumor, the total number of cases reported to date being 29. The author discusses in considerable detail the theories as to origin, anatomy and histology, signs, symptoms,

and diagnosis. Osteomas usually develop during the growth period of facial bones. Trauma is a factor in some cases as is shown by one of those reported by the author. The diagnosis can usually be made from the roentgenographic appearance which is similar to that of osteoma elsewhere. The treatment is always surgical and the pedicle and surrounding bone should be removed. The article contains the reproductions of three roentgenograms and has appended a bibliography of 67 references. Brief abstracts of the 27 cases previously reported are given.

L. W. PAUL, M.D.

The Diagnosis of Diseases of the Accessory Nasal Sinuses by Roentgen Study. Ludwig Stehr. München. med. Wchnschr., 85, 1189-1195, Aug. 5, 1938.

This is a general discussion of the implications of rhinologic disease, the clinical diagnosis, and the roentgen diagnosis, upon which much emphasis is placed. The use of standard positions is emphasized, with extra views in selected cases only. Skull fracture and inflammatory diseases receive chief attention to the exclusion of neoplasms. Some comments on the relation of infected teeth to antral disease are made.

LEWIS G. JACOBS, M.D.

Roentgen Therapy of Sinusitis. L. Popp. Strahlen-therapie, 63, 399, 1938.

During the last seven years the author has treated 25 patients with acute sinusitis and 18 with chronic sinusitis. In the acute type he applied 100 r per sitting at intervals of two days up to 600 r. In the chronic cases the single dose amounted to 200 r up to total doses of from 1,000 to 1,400 r, also given at intervals of two days. In all acute cases the treatment resulted in clinical cure. Ten of the chronic cases that had never been operated upon responded satisfactorily: six were cured and four improved. The remaining eight cases with chronic sinusitis had previously had several operations: six were cured and two improved. The author recommends, therefore, roentgen therapy of acute and chronic sinusitis, since he was able to obtain good results even in chronic cases in which surgical treatment had been unsuccessful.

ERNST A. POHLE, M.D., Ph.D.

THE SKULL

An Unusual Head Injury. Charles K. Fuller. Canad. Med. Assn. Jour., 39, 61-63, July, 1938.

The author reports a case of skull fracture occurring in a man 49 years of age, who, at the time of injury, did not lose consciousness and did not vomit. Five weeks after the accident the patient complained of a moderate headache and loss of bladder and bowel control. The only deviation from normal in the other systems was a slowness of mental response. An x-ray film of the skull, taken at this time, revealed a fracture of the roof of the left orbit and posterior wall of the frontal sinus with a fragment of bone penetrating the

frontal lobe of the brain and the left lateral ventricle. This fragment formed a connection between the cavity of the frontal sinus and the ventricle, acting as a valve. The ventricular system was pumped completely full of air, displacing all the cerebrospinal fluid.

On the fourth day following surgical intervention the involuntary defecations ceased and on the twelfth day bladder sensation was restored. Daily x-ray films were taken. On the sixth day there was a slight diminution in the volume of air in the ventricles and on the twelfth day very little air remained. Memory was lost for approximately three weeks but returned on the sixth post-operative day.

M. L. CONNELLY, M.D.

THE SPLEEN

The Treatment of Chauffard-Still's Disease. F. LePenetier. Bull. et mém. Soc. Radiol. Méd. de France, 26, 5-9, January, 1938.

Splenectomy, advanced as a procedure for the removal of a focus of infection in Chauffard-Still's disease, has, in a few cases, shown remarkable but transient beneficial effect. The author suggests that, previous to such radical intervention, the effect of roentgen therapy over the spleen should be tried, in view of the known results of small doses of roentgen rays in other inflammatory conditions.

S. R. BEATTY, M.D.

Roentgen Treatment of Certain Hemorrhagic Disorders. L. H. Garland. Calif. and West. Med., 49, 123-126, August, 1938.

This article, together with the discussion, form an important contribution to the roentgen literature as to the value of roentgen irradiation of the spleen in certain hemorrhagic disorders. There is an excellent review of the literature, together with case reports showing the effect of splenic radiation in cases of purpura hemorrhagica, with marked improvement in the blood platelet count and pronounced decrease in coagulation time. Anyone dealing with these blood dyscrasias cannot help but gain important information from this article.

JAMES J. CLARK, M.D.

THE STOMACH

The Symptoms, Diagnosis, and Treatment of Cancer of the Stomach. J. S. Horsley. Jour. Ark. Med. Soc., 35, 69-74, September, 1938.

The author discusses, briefly, the symptomatology, diagnostic methods, and treatment of gastric cancer. Concerning diagnosis he states that the most helpful aid is roentgenology but that the examination must be done by one who is skilled in the method. The most important point is early diagnosis. Surgical excision is the only satisfactory treatment for cancer of the stomach, according to the author. The article contains nothing new but is a good résumé of current opinion

on the subject as viewed from the standpoint of a surgeon.

L. W. PAUL, M.D.

Influence of Hyperthyroidism and Hypothyroidism on Gastric Evacuation. R. I. Levina. *Ekperimentalna Meditsina* [Ukrainian], 3, 35-42, 1938.

Hyperthyroidism produced very marked changes in the evacuation of the stomach. A decided inhibition of function resulted, which in some experiments was followed by acceleration.

In hypothyroidism, inhibition of function ensues in the first months after thyroidectomy. However, later on no regularity in the functional changes could be ascertained: in some cases inhibition was observed, in others acceleration, in others a normal behavior.

The author concludes that the effects of hyperthyroidism or hypothyroidism on gastric evacuation vary widely in different individuals.

ERNST A. SCHMIDT, M.D.

Hematemesis and Diaphragmatic Hernia of the Stomach. Paul Carnot and Abel Lafitte. *Arch. d. mal. de l'app. digestif*, 28, 149-159, February, 1938.

A case of diaphragmatic hernia is discussed in some detail; the clinical, radiologic, and postmortem findings are given. The chief clinical feature was the profuse frequent hematemesis without evidence of ulcer or neoplasm.

S. R. BEATTY, M.D.

Inorganic Lacunar Images of the Antrum. P. Porcher. *Arch. d. mal. de l'app. digestif*, 28, 511-515, May, 1938.

Serious errors of interpretation can occur, in examinations of the stomach, from the presence of the undigested food particles or mucus. Not uncommonly patients fail to observe the preliminary fast before coming to the radiologist for examination. In many cases, foods are retained undigested for long periods of time. Such collections of food, displacing the opaque medium, can simulate organic lesions perfectly. So, also, can non-homogeneous mixtures of thick mucus and opaque medium.

Pressure from adjacent organs or masses can also produce misleading appearances. In all cases, fluoroscopic examination should precede radiography, to eliminate such causes for error and allow the selection of the optimum positions for radiography.

S. R. BEATTY, M.D.

TELEROENTGEN THERAPY

Serious Injury of the Blood in Consequence of Teleröntgen Therapy of the Whole Body. D. den Hoed, B. Levie, and M. Straub. *Acta Radiol.*, 19, 151-163, May, 1938.

The authors report serious damage to the bone mar-

row and the peripheral blood caused by teleröntgen irradiation of the whole body according to the method of Mallet. Though part of the damage might have resulted from the focal (local) x-ray applications which were administered at the same time, the conclusion was inevitable that the principal untoward effects were due to the general body irradiations.

Twenty far-advanced cancer cases were treated in this manner, as well as ten patients suffering from leukemia or Hodgkin's disease. The treatments were immediately discontinued when the number of leukocytes had dropped to 3,000 (Mallet uses 2,500 as borderline). Blood examinations were taken at least once a week and, if feasible, radiation was resumed as soon as the leukocyte figures rose to 4,000 or 4,500.

It was generally observed that irradiation of the whole body produced (1) a rapid decrease in the total number of the leukocytes, and (2) a serious diminution of the absolute number of polymorphonuclear leukocytes and of lymphocytes. In several cases a slight relative increase in the stab and juvenile cells was found; in two cases there was a decrease of the eosinophilic cells.

The influence of general irradiation of the red blood elements was less pronounced. In some of the cases a slight decrease in the number of the erythrocytes and in the hemoglobin figures was noted.

While in some patients in whom later examinations were possible the post-radiation blood disturbances largely corrected themselves, they assumed dangerous proportions in others (leukocyte drop to 400 with practical disappearance of granulocytes and following death). Occasionally severe thrombopenia with epistaxis, purpura, and hemorrhages of the gums was observed.

The authors emphasize the necessity of extreme caution with this form of therapy and recommend it only for special cases in which no other treatment is possible.

ERNST A. SCHMIDT, M.D.

THE TONSILS

Roentgen Therapy of Chronic Tonsillitis. P. Heb. *Strahlentherapie*, 63, 393, 1938.

In chronic recurrent tonsillitis, with involvement of the lymph glands, radiation therapy has been very successful, in the author's experience. Cases without hyperplasia of the tonsils responded especially well, permanent cures being obtained in 90 per cent of such cases. For the group of cases with hyperplasia, good results were seen in 80 per cent. Roentgen therapy of diphtheria carriers is also recommended as being very successful. The author uses the following technic: 180 kv., 0.5 mm. Cu + 1 mm. Al, 30 cm. F.S.D., 6 x 8 cm. field; 165 r over each tonsillar area, given on two successive days. This may be repeated after two weeks. The report is based on the treatment of 144 cases, 101 of which could be followed and re-examined.

ERNST A. POHLE, M.D., Ph.D.

Papilloma of the Tonsil, with Report of Three Cases. Ira Frank. *Ann. Otol., Rhinol., and Laryngol.*, **47**, 715-721, September, 1938.

Three cases of hard papilloma of the tonsil are reported, verified by histologic examination. The literature is reviewed and the clinical aspects, especially the etiology, are discussed. Benign tumors of the tonsil are rare lesions. These three cases are the only ones in the records of the Department of Pathology of the Michael Reese Hospital, Chicago, during the last six years.

Most of the reported cases have been in patients varying in age from eight to forty years, and there is nothing to show that sex has any influence. Subjective symptoms are usually insignificant, perhaps limited to some irritation and soreness of the throat. If the growth is pedunculated it may form an impediment to respiration and swallowing. In this event a diagnosis of benign papilloma can be made only following histologic examination of the tumor. The treatment is electro-coagulation or better, complete removal of the affected tonsil.

L. W. PAUL, M.D.

Roentgen Therapy of Diseases of Waldeyer's Ring in Children. H. Weissig. *Strahlentherapie*, **62**, 480, 1938.

The author relates his experience with roentgen therapy in lymphatic hyperplasia in children. His material consists of 122 cases of enlarged tonsil, 118 of which could be followed up. Those with hyperplastic tonsils but without preceding inflammatory disease responded best; 62.5 per cent were cured and 28 per cent improved. The corresponding figures in children with exudative diathesis were 37.5 and 37.5 per cent. Fibrosis and indurated tonsils as they appear following repeated attacks of tonsillitis do not respond as well. In those children in whom radiation therapy was given a trial, 44.4 per cent were cured and 33 per cent improved. Especially unfavorable for radiation therapy are patients who had tonsillitis with scarlet fever: only 10 per cent were cured and 20 per cent improved. The following technic is advocated: 175 kv., 1 mm. Cu, H.V.L._{cu} = 1.2 mm., one left and one right lateral field of 6 X 8 cm. at 30 cm. F.S.D. focused on the tonsil every three days, 400 r per sitting up to 800 r total dose per area.

ERNST A. POHLE, M.D., Ph.D.

TUBERCULOSIS, SURGICAL

Sacro-iliac Tuberculosis. Fred Thompson. *Jour. Am. Med. Assn.*, **110**, 1538-1540, May 7, 1938.

This study was limited to 23 cases treated by operative fusion. There were 13 females and ten males in this series. The average age of onset was 23 years, with four patients under 15 years of age. The right side only was affected in 12 patients (52 per cent); both sides were affected in two patients. Sixteen pa-

tients (70 per cent) showed evidence of tuberculosis in other parts of the body, and the infection in all but two of these was considered active at the time of operation. Ten patients (43 per cent) had pulmonary tuberculosis; the infection was active in nine at the time the sacro-iliac joint was fused. Eight patients (35 per cent) had lesions in the vertebral bodies as well as in the sacro-iliac joint, and in three of these the infection was active. Several showed additional tuberculosis in the shoulder, wrist, elbow, ankle, hip, and sternum.

The average duration of symptoms before operation was two and a half years, the longest 14 years, and the shortest three weeks. All of the patients had pain, most commonly a dull ache in the buttock, more pronounced on standing or walking. Pain low in the back was an added feature only when there was active tuberculosis at the lumbosacral joint. Only seven patients had sciatica (30 per cent), always on the side of the affected joint; five of the seven had a large abscess in the buttock. Aspiration of the abscess relieved the sciatic pain.

Roentgenograms showed active destruction of the joint surfaces, usually near the antero-inferior margin of the joint. They were also of great value in determining the degree of fusion that had resulted from the operation.

CHARLES G. SUTHERLAND, M.D.

TUMORS (DIAGNOSIS)

Leiomyoma of the Oral Cavity. Arthur Purdy Stout. *Am. Jour. Cancer*, **34**, 31-36, September, 1938.

Two cases of leiomyoma of the oral cavity are reported: in both cases the tumor was situated on the tongue. In one case the author felt that the tumor arose from the smooth muscle of the blood vessels of the tongue and in the other case from smooth muscle in the circumvallate papillae of the tongue. Only four similar cases have been reported. In all six cases the lesions were painless. In three of the cases, followed after removal, there had been no recurrence. The paucity of smooth muscle in the oral cavity is given as the explanation for their apparent rare occurrence in this location in contrast to their more frequent occurrence in the remainder of the gastro-intestinal tract.

HAROLD O. PETERSON, M.D.

Chordoma, with Report of Two Cases. Robert F. Ridpath. *Ann. Otol., Rhinol., and Laryngol.*, **47**, 649-658, September, 1938.

Chordoma is a rare and usually fatal tumor which arises from the fetal notochord. They have been reported as occurring in various locations in the following order of frequency: in the sacro-coccygeal region in 91 cases; in the spheno-occipital region in 52 cases; in the cervical portion of the spine in 12 cases, and in other locations rarely. The majority of cranial chorda masses arise from the clivus in the region of the spheno-occipital synchondrosis. The typical ventral extension is in the direction of the nasopharynx. The salient

clinical features may be summarized as follows: A gradual onset of naso-pharyngeal and neurologic symptoms in middle-aged patients; the presence of an obstructing midline naso-pharyngeal tumor; progressive bilateral palsies of the cranial nerves, which may be quite widespread with little or no evidence of intracranial hypertension; sensory as well as motor manifestations, and symptoms arising from compression of the brain stem or the upper cervical portion of the spinal cord. Chordomas invariably prove fatal in all instances in which the patients are under observation for a long period. Operation offers only temporary amelioration of symptoms and supplementary roentgen and radium treatment are of no established benefit. Two cases of the cranial type are reported. Reproductions of the roentgenograms are included.

L. W. PAUL, M.D.

Superior Pulmonary Sulcus Tumor Simulating Subacromial Bursitis. Louis Nathanson, Lew A. Hochberg, and Robert Perlman. *Jour. Bone and Joint Surg.*, **20**, 1028-1033, October, 1938.

This detailed case report emphasizes the ever-present possibility of two distressing debilities existing simultaneously, and the great importance of differential diagnosis.

The chief complaint of shoulder pain was at first attributed to a subacromial bursitis, for which the patient was treated, and later the superior pulmonary sulcus tumor was observed, with the classical physical findings. A sequence of chest films is presented.

JOHN B. McANENY, M.D.

Renal Tumors: A Review of 130 Cases. Herman A. Soloway. *Jour. Urol.*, **40**, 477-490, October, 1938.

In a series of 130 proved cases the author concluded that hypernephroid carcinoma occurred in 70 per cent of the cases. This tumor tends to invade the renal vein and vena cava as well as metastasize to the lungs and bones. The incidence of renal tumors occurs predominantly in males and usually in the fifth and sixth decades. The ratio between white and negro patients was eight to one.

Hematuria, tumor, and pain were the early and predominant signs and symptoms, occurring in the above order of frequency. Seventeen of the patients had no urinary symptoms and no blood in the urinalysis. Metastasis occurred in 93 per cent of the autopsy cases and in 15 per cent of the operative cases.

Early and radical nephrectomy, together with pre- and post-operative x-ray therapy, is advocated.

JOHN G. MENVILLE, M.D.

A So-called Pulmonary Chondroma. Nils P. G. Edling. *Acta Radiol.*, **19**, 44-54, March, 1938.

The author describes the case of a 67-year-old woman whose roentgenograms exhibited a well-circumscribed shadow of homogeneous density in the lower half of the left chest. During hospitalization the patient died of cardiac decompensation, and the pulmonary

tumor could be examined pathologically. Histologically it was identified as a chondroma with new formation of bone tissue. The exact pathologic-anatomic diagnosis was: hamartoma chondrosarcoma pulmonis. No fat nor epithelial components (which are frequently found in chondromas) could be ascertained.

ERNST A. SCHMIDT, M.D.

Chorionepithelioma in the Male. E. J. Knoflíček. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, **58**, 57-65, 1938.

A report of two cases of chorionepithelioma in the male, with critical review of the literature, which contains reports of about 150 such tumors. This neoplasm shows rapid growth; metastasizes extensively by the blood stream in contrast to seminoma, which follows the lymphatics; produces a positive Aschheim-Zondek reaction with Prolan A and B; is accompanied by gynecomastia, and is entirely resistant to radiation therapy.

H. A. JARRE, M.D.

Observations on Chorionepithelioma Testis, with Record of a Case. Stuart McDonald, Jr. *Am. Jour. Cancer*, **34**, 1-14, September, 1938.

One hundred and forty-two cases of this condition have been reported in the literature and the author adds an additional case. In discussing the literature, one case is of interest because a patient reported by Welchman (1933) is alive and well five years after x-ray therapy. The patient not only had the primary testicular tumor, but metastases to lymph glands proved by biopsy, and clinical findings suggestive of metastases to the lungs, liver, and spine.

In discussing the histogenesis of the tumor the author holds that while the tumor arises through malignant differentiation of a teratoma, endocrine observations support the belief that chorionepithelioma testis is morphologically identical with uterine chorionepithelioma. He also advocates a quantitative Aschheim-Zondek test in the study of testicular tumors.

HAROLD O. PETERSON, M.D.

TUMORS (THERAPY)

The Results of Treatment of Osteogenic Sarcoma. Henry W. Meyerding. *Jour. Bone and Joint Surg.*, **20**, 933-948, October, 1938.

In reviewing 187 cases of osteogenic sarcoma with microscopic diagnosis the author has found great value in the grading of the malignancy by the pathologist, and deems it of importance in selecting the type of treatment. The most frequent position of this tumor is about the knee, next the pelvis, then the shoulder. Biopsy is always advised.

In treatment, excision, used in the least malignant growths and when amputation was impossible, resulted in a 34.1 per cent five-year cures. Amputation resulted in 24.7 per cent of cures. Irradiation following biopsy is credited with 9.1 per cent of cures.

JOHN B. McANENY, M.D.

Three-year Cure of a Case of Melanosarcoma. Drevon and Mourgues. *Bull. et mém. Soc. de Radiol. Méd. de France*, **26**, 73-77, January, 1938.

A case of melanosarcoma of the palm of the hand treated by extensive electrocoagulation shows no evidence of recurrence or of metastasis after three years. A pronounced melanuria has disappeared. The histology and differential diagnosis of pigmented neoplasms are briefly discussed.

S. R. BEATTY, M.D.

The Surgical Standpoint Regarding Radiation Therapy of Malignant Tumors. F. Sauerbruch, in collaboration with K. Middeldorpf. *Strahlentherapie*, **63**, 256, 1938.

The famous chest surgeon of the University of Berlin outlines his conception of the proper relationship between surgical and radiological procedures. He concludes that only by close co-operation and the absence of any competitive spirit between surgeon and radiologist will we succeed in improving our results in the treatment of malignant neoplasms.

ERNST A. POHLE, M.D., Ph.D.

Mixed Tumors of the Hard Palate. Frederick T. Hill. *Ann. Otol., Rhinol., and Laryngol.*, **47**, 317-325, June, 1938.

The author discusses the differential diagnosis of mixed tumors situated in the hard palate and reports four cases. These tumors are not especially common. They may occur at almost any age but are commonest in the fourth decade. They usually have been present for years without symptoms, except such as may be due to location and size. They are usually single, circumscribed, sessile, and with a smooth non-ulcerating surface. Among the lesions with which they may be confused are inflammatory abscess, gumma, osteoma, sarcoma, or epithelioma. Biopsy may be needed to establish the correct diagnosis. These tumors are generally regarded as potentially malignant and tend to recur after removal. Complete surgical removal, to be followed by post-operative radiation, if the histological examination shows malignant tendencies, is the generally accepted treatment. The histological picture is similar to mixed tumor of the parotid but carcinoma-like changes are far less common.

L. W. PAUL, M.D.

The Meningiomas: From a Roentgenological Viewpoint. Charles Wadsworth Schwartz. *Am. Jour. Roentgenol. and Rad. Ther.*, **39**, 698-712, May, 1938.

Meningiomas constitute about 15 per cent of all intracranial tumors. On the whole, they grow very slowly. Grossly, there are the roughly globular, well encapsulated, and the flat, poorly encapsulated types. Neither metastasizes, although the flat type

may invade the overlying bone which is then stimulated to produce hyperostoses. They are most likely to occur where the arachnoid granulations are most common.

In the group of 129 cases discussed, 79 per cent showed definite x-ray evidence of intracranial pathology and in all but 26 a diagnosis of meningioma was possible. The location and extent was, however, frequently uncertain, but, with encephalography, positive findings resulted.

Roentgen findings, though not always present, consisted of atrophy of the sella turcica (50 per cent) and localized hypervascularity (25 per cent). Localized hyperostosis was present in 33 per cent, recognizable calcium deposit in 2 per cent, and localized bone atrophy from direct pressure in 0.5 per cent.

Radiation therapy is disappointing since only a small percentage of cases show mitotic figures, but in these, from 2,500 to 3,000 r with the protracted method should be tried.

S. M. ATKINS, M.D.

Adamantinoma of the Tibia. Benjamin Wolfort and David Sloane. *Jour. Bone and Joint Surg.*, **20**, 1011-1018, October, 1938.

After a review of the literature, the authors report two additional cases of adamantinoma of the tibia, as shown by biopsy. The roentgenographic picture is not diagnostic, nor does the growth seem to be affected by irradiation.

JOHN B. McANENY, M.D.

Progress of a Case of Lymphocytoma. Brillouet and A. Viel. *Bull. et mém. Soc. de Radiol. méd. de France*, **26**, 233, 234, April, 1938.

The authors trace the progress of a case of lymphocytoma treated with roentgen rays at various times for lesions of the tonsil, rectum, mediastinal nodes, and pelvic region. This case was maintained in good health for almost six and one-half years.

S. R. BEATTY, M.D.

Renal Tumors. James C. McClelland and Jesse R. F. Mills. *Urol. and Cutan. Rev.*, **42**, 631-634, September, 1938.

Sixty-nine cases of renal tumor are reported, 44 of which were examined pathologically. The etiology, pathology, sex incidence, symptoms, examination, diagnosis, x-rays, treatment, and results are reviewed.

In treatment, the authors stated that 13 cases received deep x-ray treatment but admitted that in most of these cases the growth was so advanced that x-ray therapy was used as a last resort. With few exceptions the results were discouraging. Late diagnosis was given as the outstanding reason for the poor results. The authors are using 400,000 volts as a pre-operative treatment for their present cases.

JOHN G. MENVILLE, M.D.

THE UTERUS

The Treatment of Carcinoma of the Cervix in the Women's Clinic of the University of Königsberg from 1910 to 1937. F. v. Mikulicz-Radecki. *Strahlentherapie*, **63**, 414, 1938.

During the period covered by this report, 1,479 women with carcinoma of the cervix were admitted to the author's clinic and he presents a complete statistical analysis of this material. Of 1,071 patients treated during the last 22 years, 169 (or 15.7 per cent) were free from disease after a five-year period. This percentage is not as good as that given in other statistics and is explained by the fact that before 1919 radium and roentgen technic were still in their infancy. Since 1932, operable cases of Groups I and II have been operated upon and the author prefers the vaginal radical extirpation. From 1932 to 1937, a total of 458 cases of carcinoma of the cervix were seen. Thirty-four per cent were operated upon with a mortality of 4.4 per cent. The remaining patients were subjected to irradiation with a mortality of 3 per cent. Combined x-ray and radium therapy was used. Only 50 cases treated during 1932 were available for a five-year follow-up. Seven of these belonged to Group I, 18 to Group II, 24 to Group III, and one to Group IV. The respective numbers cured were seven, six, two, and none; six in Group I were operated upon and one was irradiated; six in Group II operated upon, and the two in Group III were irradiated. These results again clearly indicate the importance of early diagnosis and treatment.

ERNST A. POHLE, M.D., Ph.D.

Factors Relating to Treatment of the Cervix Uteri. G. H. Johnson. *Jour. Ark. Med. Soc.*, **35**, 74-77, September, 1938.

This article details the method used in treating cancer of the cervix at the Folsom Clinic of the University of Arkansas School of Medicine. It follows closely the technic used at the Josephine Lendrim Tumor Clinic of the Paterson General Hospital, in Paterson, N. J. The intra-uterine radium capsule is made up of a number of platinum cells each containing 3.33 mg. of radium. A Curie colpostat is used for vaginal irradiation. Most patients receive radium before x-ray treatment is given. Those with advanced lesions usually are given a course of roentgen irradiation first. This is given through multiple pelvic portals by the protracted method. The radium for intra-uterine application is filtered through 1 mm. of platinum, 40 mg. of radium being used with an additional 40 mg. in the vaginal colpostat. A total

dose of about 6,000 mg.-hours is given which requires 75 hours to deliver.

L. W. PAUL, M.D.

Thirty Years' Experience in the Treatment of Carcinoma of the Uterus. A. Mayer. *Strahlentherapie*, **63**, 407, 1938.

In the Women's Clinic of the University of Tübingen, carcinoma of the cervix is usually treated by a combination of x-rays and radium. In operable cases of carcinoma of the fundus, operation is given preference. Intra-uterine radium application is considered contraindicated if there is necrosis or suspicion of carcinomatous infiltration of the uterine wall which might lead to perforation following radium therapy. Carcinoma of the cervix during pregnancy is also operated upon as well as the adenocarcinoma of the cervical canal. The author likewise recommends operation in carcinoma of the cervix in young women. Patients who have radiation therapy and do not show any response within six or eight weeks are also operated upon. The same is done with cases in which the cervical growth disappears and heals while a bloody discharge remains, indicating newgrowth in the depth. Vaginal stenosis following irradiation with continued discharge, and operable recurrences following irradiation, are also sometimes referred to surgery.

ERNST A. POHLE, M.D., Ph.D.

THE WRIST

Os Centrale of the Wrist. R. O. Tanguy. *Bull. et Mém. de Radiol. Méd. de France*, **26**, 192-194, March, 1938.

Illustrations of a case of "os centrale," without calcification of the anomalous bone, are presented.

S. R. BEATTY, M.D.

Traumatic Axial Rotation by Gear Movement of the Carpal Scaphoid and Trapezium with Subluxation and Foreshortening of the First Metacarpal. Adolph A. Schmier and Michael S. Burman. *Am. Jour. Roentgenol. and Rad. Ther.*, **39**, 945-949, June, 1938.

An unusual type of injury to the carpal scaphoid and trapezium is described and illustrated by photographs, radiographs, and a cadaver study of the mechanics involved.

IRVING I. COWAN, M.D.

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